DOCUMENT RESUME

ED 210 783 EA 014 257

AUTHOR Cohen, Elizabeth G.; Intili, Jo Ann
TITLE Interdependence and Management in Bilingual Classrooms. Final Report.
INSTITUTION Stanford Univ., Calif. Center for Educational Research at Stanford.
SPONS AGENCY National Inst. of Education (ED), Washington, D.C.
PUB DATE Aug 81
CONTRACT NIE-G-80-0127
NOTE 206p.; Not available in paper copy due to marginal legibility of Appendices A and B.

EDRS PRICE MF01 Plus postage. PC Not Available from EDRS.
DESCRIPTORS Academic Achievement; Bilingual Education; *Curriculum Development; Elementary Secondary Education; Group Activities; Outcomes of Education; *Peer Teaching; *Program Implementation; Social Science Research; Social Studies; *Student Participation

ABSTRACT

Using a sociological conceptualization of curriculum implementation, this study looked at the relationship between implementation and learning outcomes. The specific curriculum examined was a complex math-science curriculum for language minority students in grades 2-4. The study looked particularly at the effect on learning outcomes of allowing students to assist each other or work together. More generally, it examined the relationship of several aspects of curriculum implementation on learning. Subjects were teachers and students in nine bilingual classrooms in San Jose (California). Data were gathered through observation of students and teachers and through content-referenced and standardized tests of student achievement. Major results include the following: (1) Talking and working together was a predictor of achievement gains on the content-referenced test. (2) Reading and writing behavior was a predictor of gains on the standardized test. (3) The quality of performance on the worksheets was a predictor of gains on standardized tests. (4) The level of engagement in the task was unusually high with this curriculum. More general findings emerged when a sociological perspective was applied: productivity of students and occurrence of prescribed learning behaviors were direct predictors of learning outcomes; degree of differentiation of the technology was linked only indirectly to learning outcomes. (Author/JM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

Center for Educational Research at Stanford

CERAS

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED210783

INTERDEPENDENCE AND MANAGEMENT IN BILINGUAL CLASSROOMS

Final Report

Contract Number NIE - G - 80 - 0127

by

Elizabeth G. Cohen
Principal Investigator

Jo Ann Intili, Ph.D.
Associate Investigator

Project Affiliate
Edward DeAvila, Ph.D.
Senior Research Associate

August, 1981

SCHOOL OF EDUCATION STANFORD UNIVERSITY STANFORD, CALIFORNIA 94305 (415) 497-4717
SCHOOL OF EDUCATION STANFORD UNIVERSITY STANFORD, CALIFORNIA 94305 (415) 497-4717

EA 014 257

ACKNOWLEDGEMENTS

The authors would like to acknowledge the contribution of project research assistants. They played a critical role in data collection, management, and analysis. They are: Barbara Anthony, Sue Hanson, Susanna Mata, Cecilia Navarette, and Nancy Stone. Particularly important in the preparation of this report were Barbara Anthony and Brenda Stevenson.

A large and complex project of this kind cannot be carried out without the coordination and management of a first-rate staff. We are very grateful to Barbara Wigton and Brenda Lehmann who fulfilled this task so admirably.

TABLE OF CONTENTS

	Page
Introduction	1
Theoretical Framework	5
The Setting and the Sample	14
Procedure	16
Measurement Section	17
Results	30
Discussion	70
Summary and Conclusions	88
References	98
Tables	100 - 114
Appendix A - D	115

TABLES

		Page
Table 1	Description of the Participants in the Experiment by Grade Level and Student Age	100
Table 2	Description of the Student Participants in the Experiment by Level of Language Proficiency	100
Table 3	Reliability of Teacher Observation Instrument	101
Table 4	Reliability of Whole Class Observation Instrument	102
Table 5	Reliability of Target Child Instrument	103
Table 6	Classroom Variation in Criterion Referenced Test and Standardized Achievement Test: Class Mean Scores on Pre and Post-Test	104
Table 7	Curriculum Weeks Completed by Each Classroom	105
Table 8	Frequency of Expected Teacher Implementation Behavior to Individuals and Groups in the Class	46
Table 9	Variation Among Teachers in Percent of Students Involved in Mediating Learning Activities, Differentiation of the Curriculum and Student Proficiency	106
Table 10	Average Frequency per Three Minutes for Target Child Working Together with Peers; Means and S.D.'s for Nine Classrooms	107
Table 11	Relationship of Observed Behaviors to Post-Test Scores: Partialing Out Effect of Pre-Test Scores	108
Table 12	Zero Order Correlations Among Implementation and Outcome Measures	109
Table 13	The Relation of Implementation to Learning Outcomes, Controlling for Mean Level of Knowledge of Math/Science Before Implementation	110
Table 14	Frequency Distribution of Rates of Off Task Engagement	111
Table 15	Zero Order Intercorrelations of Implementation and Learning Measures: Individual Target Children	112

TABLES (continued)

		Page
Table 16	Regression on Three Learning Measures of Observed Rate of Disengagement for Target Children: Holding Constant Pre-Test Scores and Classroom Level of Differentiation	113
Table 17	Regression on Three Learning Measures of Observed Rate of Reading/Writing and Talking/Working Together: Holding Constant Pre-Test Scores and Classroom Level of Differentiation of Target Children	114

Interdependence and Management of Bilingual Classrooms

Final Report to NIE

INTRODUCTION

This is the final report on the first part of a two part secondary analysis. The first analysis is a study of implementation and its relation to learning outcomes; the second analysis we have planned is a study of interdependence of staff, classroom management and the relationship of these variables to effective implementation. We have completed the first analysis in this year's work.

A major portion of this year's work lay in the sociological conceptualization of curriculum implementation. Using a general formulation of the concept, we have developed indicators of the relevant dimensions. The analysis consisted of applying these ideas to a body of data collected on implementation of a complex math-science curriculum designed for language minority children. The data are drawn from nine elementary school classrooms which used the curriculum. We have examined variation in implementation in these nine classrooms and have related this variation to learning at both the classroom and individual level.

The analysis is far more than a straightforward evaluation of curriculum effectiveness. We already know that experiencing this curriculum was associated with significant

gains in science knowledge, math achievement test scores, reading achievement, and linguistic proficiency (De Avila,-1981). In order to analyze implementation, we use the concept of technology. There are several dimensions which organizational sociologists use to characterize the complexity of technology. We have taken these dimensions and have characterized the math-science curriculum as originally planned and the observable complexity of the curriculum as implemented in the nine classrooms.

The math-science curriculum we studied was originally planned as complex instruction; it calls for multiple learning centers each with different materials and activities. Furthermore, these learning centers are designed to operate simultaneously in the classsroom with four or five children working at each center. This is a far cry, technologically speaking, from traditional large group instruction.

In addition, the curriculum requires the learners to follow novel task instructions at multiple learning centers. From a sociological point of view, there is a good deal of task uncertainty for the learner. Unless the teacher finds some way to deal with this uncertainty, many students will become confused and fail to benefit from their learning tasks. We have often heard this complaint from teachers who have tried to use multiple learning centers.

Simultaneous use of a wide variety of materials in a classroom offers great advantages for learning; it allows the teacher to adapt to students who are on different levels

of academic achievement. In the case of the curriculum we studied, multiple media were used in conjunction with multiple activities; this was done to allow children at different levels of cognitive development to benefit from the learning center tasks. This curriculum had the additional feature of instructions at each learning center appearing in English, Spanish and pictographs. Although the bilingual character of the instructions increases the complexity of the technology, it provides the kind of redundancy in communication which allows students who speak only Spanish and students who have limited proficiency in both English and Spanish to understand what they must do without the special intervention of the teacher.

This curriculum represents a common problem of implementation of innovative curricula requiring multiple materials, media and activity centers. In order to maintain effective control over different students doing so many different things, the teacher must either delegate authority to the learners themselves to manage much of their own behavior or cut down on the level of complexity to the point where routine bureaucratic supervision will be effective in controlling behavior. If the teacher fails to delegate authority while maintaining a high level of complexity, s/he will not be able to maintain any degree of control over what is going on.

Giving up the role of direct supervisor and instructor is not easy for many teachers. They are concerned about loss

of control when students are engaged in so many different activities. Science educators (and other developers of complex instruction) have often observed the failure of teachers to use the curricula they prepare as originally designed. The problem is also observable with curricula designed for multiple groupings of students in programs of individualized instruction. Mcdonald and Elias report increased management problems associated with use of multiple materials in individualized classrooms (1975).

In this analysis we can examine the effect of delegating authority to the children, (allowing them to assist each other) on learning outcomes. Some of the teachers in our study made much more use of lateral relations between the students than others. This analysis is of general interest to educators working with complex instruction; it yields information on the effectiveness of a pattern of classroom organization when one is working with complex instruction.

In addition to this issue, a second feature of this analysis is the detailed conceptualization of the implementation process. We examine the relationship of multiple dimensions of implementation to different learning outcomes. This analysis helps to pinpoint which features of classroom activity and pupil behavior are most closely related to which kind of test outcomes.

Other studies of implementation led us to expect that there would be significant deviations from the developer's original design, especially in the direction of reducing com-

plexity. Our conceptualization allowed us to examine how each classroom stood on multiple dimensions of implementation. We were able to study the power of each dimension to predict learning outcomes.

Through this analysis we were able to ascertain which features of the curriculum are absolutely essential to learning and which design features may be altered according to individual preference without appreciable loss of learning. This procedure permits us to develop a set of general principles for guiding the practitioner. S/he is free to adapt some features to her own style, but understands the risks in altering other features.

THEORETICAL FRAMEWORK

This section will introduce the sociological concepts and hypotheses tested in the analyses reported here. As described above there are two major analyses: The first analysis tests the effectiveness of a pattern of classroom organization for learning, given a well prepared set of curriculum materials which are designed to be used simultaneously; the second analysis examines the relationship of multiple dimensions of implementation of the curriculum to learning outcomes at the classroom and individual level.

Technology

To sociologists the concept of technology does not necessarily imply use of machines. Rather it is a conception of a task as a series of means-end sequences (cf Waldo,1969). Sociologists working at Stanford University in the Environment for Teaching Program, developed an application of the concept of technology to classroom instruction. The two major dimensions that have been found useful for analysis are: degree of differentiation and routinization of decision making. Classes are seen as more complex in their technology to the extent that their activities are more differentiated and their implementation requires non-routine decision-making.

In this view, the traditional method of teaching where the class is assigned a task as a whole or sits as a group, listening to the teacher talk, is similar to large batch processing in industry. The student completes the standardized task in the prescribed manner and attains the desired outcomes. Instruction of this type shows a low degree of differentiation and a low level of non-routine decision-making.

In contrast, many of the elementary school classrooms studied by the Environment for Teaching had multiple materials and groups in simultaneous usage. As the method of instruction utilizes multiple materials, activities and grouping patterns simultaneously, the technology is said to be increasingly differentiated. The introduction of individualization techniques to the teaching of basic skills for the elementary school has meant the rapid growth of a differentia-

ted technology of teaching (See Cohen,Deal,Meyer & Scott,1979 for description of this trend.).

The curriculum Finding Out/Descrubrimiento, represents a highly differentiated technology. At any one time there are up to 12 learning centers in a classroom. Each learning center features an entirely different activity involving its own set of goals, manipulable materials and worksheets. The instructions are available at each learning center in English, Spanish and in pictographs. Children are in a variety of grouping patterns. Some are working by themselves; others are working together on worksheets or manipulating materials together or talking over what they are to do at the learning center. These groups may range from two through five children. The size of the group is determined by the nature of the activities, the teacher's directions and the children's decisions.

The second dimension of technology, routinization of decision-making, refers to the way in which the workers in charge of the operation make decisions about how the work will be done. If a task has been standardized or if work is governed by a set of traditions as to "how things should be done," then decision-making is more routine. In the third grade, for example, tradition dictates that everyone should take up the study of fractions. Examples of non-routine decision-masking in modern teaching methods are individualized instruction requiring the teacher to diagnose and prescribe for the needs of individual learners or open classrooms

where children are allowed make many of the decisions for themselves.

In some ways the instructional decison-making in Finding Out/Descrubrimiento is routinized. Each child is presented with the same instructions and carefully prepared materials at a given learning center. Furthermore each child is supposed to complete tasks at each center and fill out the same worksheet. The tasks are designed so that children who vary in level of cognitive development will work the task somewhat differently. No task is set up so that children who are at a lower level of development are prevented from completing the activity. This design feature saves the teacher making decisions as to how to adjust the character of the task for individual differences.

There remain individual differences the teacher must take into account in running this curriculum. For example, there are many non-readers; some provision must be made for their understanding of the instructions. Furthermore, some children require much more guidance than others in finding their way through a novel set of instructions. Some children will require more time and attention in feedback on their worksheets. From the curriculum developer's point of view an important role for the teacher is to extend the depth and cognitive level of the child's inquiry. Some students who may be developmentally capable of dealing with the problem on an advanced or more abstract level, will need to be encouraged to do so by the teacher asking critical questions.

Thus if this curriculum is to be properly implemented teachers must still observe individuals and make non-routine decisons about special attention and treatment they should receive.

In this year's analysis we make limited use of the concept of non-routine decision-making from the teacher's point of view. We have simply examined the extent to which she gave individuals special attention and treatment in the way the developer intended.

Technology and Work Arrangements

As technology grows in complexity, there is an increase in the use of lateral relations as channels for communication (March & Simon,1958; Van de Ven, A.H., et al.,1976). The function of lateral relations is to deal with the uncertainty so characteristic of more complex tasks; people who talk with each other are much more likely to solve difficult problems than people who work by themselves. If these work arrangements do not shift to "match" the technology, then productivity declines and there is a loss of organizational effectiveness (Perrow,1961). These theorists argue that it is necessary to substitute horizontal communication and mutual adjustment for hierarchical authority.

Perrow's proposition is the basis for the first hypothesis. We argue that the learning center tasks in the curricu-

lum represent highly uncertain problems requiring solutions from the students. Each task is novel;the student must find his/her way through the instructions in order to manipulate the materials and fill out the worksheet. If the teacher fails to delegate authority to the children to use each other as resources (lateral relations), we should see weaker of learning outcomes. This will happen because the teacher cannot be everywhere at once to provide resources necessary for the students to carry out their learning tasks.

Hypothesis 1

Given the high level of differentiation in this curriculum, the frequency of lateral relations between students will be associated with learning gains.

In the above hypothesis we have identified Perrow's concept of "organizational effectiveness" with learning gains. The desired match between work arrangements and technology occurs when the teacher delegates authority to lateral relations in dealing with the managerial problems produced by a high level of differentiation. It should be pointed out that we have taken the novel step of considering the lateral relations of the students as a work arrangement. As in other studies of workers, we are hypothesizing that the interdependence of student-workers serves to solve problems in connection with getting their "job" done.

Implementation and Learning Outcomes

Research on implementation of curricula reveals a process of adaptation in which it is common to find that the curriculum or program becomes almost unrecognizable as it is adapted to local conditions. This insight has brought into question the earlier practice of conceptualizing implementation solely in terms of its "fidelity" to the developer's views of what ought to take place in the classrooms using that curriculum. Fullan and others have urged that the process of adaptation is a worthy subject of study for those who want to understand how changes take place in the practices of educational organizations (Fullan,1980).

Our approach to the study of implementation has some aspects of the "fidelity" approach, although our major questions resemble what Fullan and Berman have called the programmed perspective (Fullan,1980; Berman,1979). The programmed approach to implementation consists of an explicit attempt to assess the degree of implementation over time within a given population of users, and to use this information to identify variations of use in order to facilitate more faithful implementation or examine the relationship between implementation and student achievement.

The sociological conceptualization of the curriculum leads to the expectation that the curriculum will be implemented (or adapted) in different directions in different

classrooms, and that those directions are predictable by the teacher's management strategies. The issue of management of the differentiation of the curriculum is likely to produce weaknesses in particular dimensions of implementation. We can predict that a major difference between classrooms will be in the level of differentiation that is maintained. If the teacher is experiencing the management problems which often accompany a high level of differentiation, some of them will undoubtedly try to solve the problem by lowering the level of differentiation. The consequence of this particular adaptation will be less complex instruction than the developer intended. Students will be working in larger groups under more direct supervision of the teacher and will not be able to work things out for themselves with as great a variety of media and activities. Thus there should be a decrease in productive behavior on the part of the students.

Using organizational sociology, we have conceptualized implementation so as to capture the extent to which both productivity and differentiation are maintained in each classroom. Examining the relationships between these dimensions and learning outcomes yields some information about the "costliness" of management problems and directs the developer to the critical issues of increased organizational support for the teaching staff who are working with this curriculum.

In review, this discussion proposes two dimensions of implementation of a highly differentiated and rationalized

curriculum. Abstractly stated, these are: productivity and level of differentiation. The level of differentiation refers to the observed extent to which different activity/treatments/grouping patterns are in simultaneous operation in the classroom. The productivity dimension refers to the outputs of student performance.

In addition to these two dimensions there is a third: prescribed learning behavior. This dimension refers to the developer's conception about a mediating learning process. This particular curriculum is based on an explicit rationale about the conditions under which children will develop thinking skills. The learning materials and the prescribed activities are constructed to conform to the developer's theory. The data may or may not support the developer's theory, but an evaluation of the curriculum may be taken as a "test" of that theory. The dimension of prescribed learning behavior, then, refers to the behaviors we should see in a classroom if, from the developer's perspective, the students are using the curriculum materials and activities in the way that is supposed to promote learning.

The three dimensions of implementation just described should be related to learning outcomes. In other words the extent to which the learner experiences a high level of differentiation, exhibits a higher level of productivity, is seen to be engaged in the prescribed learning behaviors---all these should individually and collectively be related to learning outcomes.

Hypothesis 2 For a given level of pre-test scores, learning outcomes of the curriculum will be related to the observed differentiation, productivity and frequency of mediating learning behaviors.

Up to this point we have stayed very close to the students and have not touched the teacher's role apart from the issues of management. However, this curriculum, it will be recalled, does require some non-routine decision making on the part of the teacher. The teacher is required to decide which children are operating on too low a level and to extend activities by asking questions. She was also required to decide when children were in need of instruction and feedback on their worksheets. The shift from direct instruction to this kind of a pattern is precisely the kind of a role shift which causes so many programs and curricula to fail in the process of implementation (Fullan,1980).

Examination of the data should yield the answer to two questions: How successful was the in-service in persuading the teacher to adopt the prescribed role? And, what is the relationship between the extent to which as given teacher played the prescribed role and learning outcomes?

THE SETTING AND THE SAMPLE

Finding Out/Descrubrimiento was used in nine bilingual classrooms, with 307 students, in grades two through four. These represented nine schools in six different districts, all of which were part of the Bilingual Consortium of San Jose. Each classroom was staffed with a teacher and an aide. The sample of teachers participating consisted of volunteers recruited through oral presentation and a recruitment questionnaire, to meet minimum implementation criteria. These criteria were a positive attitude toward use of learning centers, availability of an aide who would work with the teacher in classroom instruction for at least three hours during the day; and administrative support for the teacher's involvement in the experiment.

Two Conditions for Teachers

The sample of teachers participating in the program was divided into two experimental conditions: the intensive and the economic. Five of the nine teacher-aide teams received special in-service, designed to improve the way they functioned as a team---the intensive condition. All nine teachers and seven of the nine aides were given a three day workshop, training them in the use of the activities. During this time they worked with the activities; the rationale underlying the program was explained; they practiced the extension of activities and drawing out of inferences we were advocating; and they heard a description of classroom manage-

ment and record-keeping procedures. Much of the information was supplied in a handbook for teachers. A follow-up session, conducted either in a group or individually, took place after the teachers had completed at least three weeks of the activities.

The Students

Three hundred and seven students, in all, participated in the experience. This number, however, includes about 30 students who came in late, left early, or were generally absent. The classes were made up largely of children of Hispanic background, with a small proportion of Anglos, Blacks and Asians. Parental background was working class and lower white collar. There were a few children from welfare families. We had been warned by the principals of the schools to expect a high proportion of transient students, some from migrant families. Our absenteeism rates were well below what we expected. Tables 1 and 2 summarize the participating sample, by grade and language proficiency.

TABLES 1 AND 2 HERE

PROCEDURE

Finding Out/Descrubrimento was designed for use an hour per day, four days a week, for 14 weeks; all students

were to complete each of the 170 activities provided, along with the accompanying worksheets. In practice, the activities were used in classrooms for varying amounts of time per day, and days per week.

In response to complaints from the teachers about the amount of work in handling 12 centers at a time, the project staff reduced the recommended number to six per week. All learning center materials continued to be delivered to the classrooms, but the recommended centers were so marked. Some teachers incorporated the use of the activities into their other subject areas. They used the instruction for the activities as part of the reading lesson. They selected the new scientific words for vocabulary development. Some used the math activities as part of their math lessons. Other teachers maintained a special segment of the day for the curriculum with no integration of its materials with the rest of the day's activities. Some classes finished all 14 weeks; others only half that many.

Before and after the curriculum, all classrooms participated in test administration, allowing us to evaluate the learning outcomes. In addition, each classroom experienced frequent visits from observers who collected systematic data on the process of implementation.

MEASUREMENT SECTION

Instrumentation and Data Sources:Overview

The data bank on which this secondary analysis was performed contains a variety of measures taken over time and on different levels. In this section we will describe only the instruments used in the analysis; description will include procedures for data collection and reliability data. Detailed copies of these instruments and their manuals are included in the appendices to this technical report.

Following this description of the instruments is a discussion of the general strategy used to test the hypotheses. We will also discuss how measures were aggregated across time for classrooms and individuals after assuring ourselves that there was sufficient stability in the measurements to permit aggregation. The statistical procedures to be used will also be described.

The description of the specific indices used in the analyses will be included with the results because it is difficult to keep in mind the nature of each of these complex indices. The source of each of these indices in particular measuring instruments is specified; furthermore, the methods used to create an index are described.

Description of Classroom Behavioral Instruments

There were three instruments designed to take systematic observational data in the classrooms during the course

of the curriculum: one examined teacher behavior, one focused on individual student behavior, and a third examined patterns of activities and grouping at the classroom level. These three instruments provided process measures of behavior of relevant actors at the classroom and individual level during the implementation of the curriculum.

Once a week, from October through April, two project staff members observed use of the curriculum activities in the classroom using these three instruments. In addition to the observational instruments we had an objective measure of the productive behavior of students. As a measure of the output of individuals, we collected worksheets the children had filled out in connection with the learning centers. The average number of worksheets per child is an important variable distinguishing classrooms in this analysis. In addition, quality of performance on these worksheets was scored for a subset of children in the nine classrooms.

Teacher Behavior Instrument. We examined teacher behavior through an instrument developed specifically for this project. Unlike most available measures of classroom teacher behavior this instrument focuses entirely on coordination, control, and instruction rather than on details such as the nature of teacher questions. In addition, this instrument counts the number of different individuals contacted by the teacher and the language used by the teacher in speaking to those individuals.

The teacher behavior instrument also provides specific measures of the extent to which the teachers followed the developer's instructions on extending activities of individual children and providing specific feedback on worksheets. It also permits an examination of the effectiveness and necessity of the teacher playing a direct instructional role as compared to the role of a manager and facilitator. This instrument was administered for a 15 minute period every time the observer visited the classroom. Selected behaviors were checked off as they occurred.

The reliability of this instrument was assessed in two phases. In the first phase, each classroom observer was paired with a supervisor who scored alongside the observer. No observer was allowed to score on his/her own until a satisfactory level of agreement with the supervisor's scoring was reached. This was calculated by comparing the total number of checks made by the observer and the supervisor for a scoring period for each category on the scoring instrument. The formula used to assess the level of agreement was:

$$\frac{\text{\# disagreements of scorer with criterion scorer}}{\text{Total possible points of disagreement between two scorers.}}$$

No observers were allowed to visit classrooms on their own until they had reached an acceptable level of agreement with the supervisor. This was defined as .90

agreement. The two supervisors were Cohen and Intili, who created the instrument. The instrument was accompanied by a detailed scoring manual which is included in Appendix A.

During the scoring, each observer received two visits from one of the supervisors. Reliability checks were made at those times. Table 3 gives the results of the reliability checks made during the course of scoring the Teacher Behavior Instrument. The level of agreement was .90 or better in most cases.

With this instrument, as with the other behavioral instruments, we followed the additional procedure of regular staff meetings at which difficult points of scoring were discussed. Sometimes these resulted in changes in the scoring manual. In these cases, we chose to improve the procedures even though scoring was already underway rather than accept a faulty procedure. In no case did one of these changes involve a variable used in this analysis.

INSERT TABLE 3 ABOUT HERE

Whole Class Observation Instrument. This instrument was an adaptation of the earlier work of the Environment for Teaching Program and the Status Equalization Project at Stanford (both supported by NIE). The observer checks off the location of students and teacher (and aide) in a matrix made up of rows of grouping patterns and columns of activity types. It is designed to provide an overview of the differen-

tiation of the technology and the occurrence of particular patterns and activities which are of special interest to the investigator. In this particular version, we gathered data on the degree of differentiation and the occurrence of activities which the developer prescribed as part of the mediating learning process.

The observer used this instrument at the beginning and end of each classroom visit. The initial scoring was not taken until the period of science activities had progressed for at least seven minutes. The observer recorded the number of students in the class and how they were distributed across grouping patterns: working alone, in pairs, in small groups (3-6 students), and in larger groups. Using the matrix, the coder also classified each of the students as to the kind of activity the student was engaged in as well as the grouping arrangement in which he/she was working. Activity scores distinguished reading/writing; manipulating materials without talking; talking/discussing[1]; mixed manipulation of materials and talking; thinking/observing/listening; other academic work; clean -up;wandering/playing; in transition on business; in transition not on business; or waiting for the teacher. The observer also noted the number of learning centers posted and in use during the class, noting the names of the centers.

This instrument took approximately five minutes to complete. Reliability was assessed in two phases and with the same procedures as those described above. Table 4 shows the

results of the reliability checks for this instrument. The percentage of agreement was typically over .90.

INSERT TABLE 4 ABOUT HERE

Target Child Observation. In order to measure individual behavior, we selected out two sets of target children. One set of target children consisted of a sample stratified by language proficiency (Spanish and English). A second set of children was selected from each classroom on the basis of the teacher's judgement that they presented difficult teaching problems in math. There was some overlap between these two samples; the total set of target children contained 101 S's.

The sample of target children stratified by language proficiency was observed at the same time the observers gathered data on the Whole Class Instrument and the Teacher Behavior Instrument. Two observers visited the classroom together for this purpose, with one using the Whole Class and Teacher Behavior Instruments, while the other scored each target child for three minutes. The second set of target children was scored by another observer on another weekly visit to each classroom with the same standardized instrument. (For a detailed discussion of the purpose of collecting data on this second set of children, see Rosenholtz,1981).

The purpose of the target child observation was to obtain timed observation of task-related behavior on selected

children. The observer began the scoring period for each child by recording the nature of the activity and grouping pattern in which the child was operating. If an aide or teacher were directly supervising the student, this was also recorded. For each 30 second interval of a three minute period the observer would record the frequency of task-related talk, working alone or together on the curriculum, off-task behavior, as well as other behaviors not directly relevant to this analysis.(For a detailed manual and a sample scoring sheet ,see Appendix A). In addition to recording selected behaviors,the observer recorded whether the target of the talk was peer or adult and the language the child was using.

The order in which the target children were scored was varied on each visit. The observer was supplied with a randomized order for scoring. This was done so that a child would not always be observed at the beginning or the end of the period when task disengagement might be more common.

The reliability of this instrument was assessed in exactly the same fashion as the above two instruments. The agreement statistics are given in Table 5 below. The level of reliability on this instrument was also satisfactory.

INSERT TABLE 5 ABOUT HERE

Learning Outcome Measures. A content-referenced test especially constructed to measure learning outcomes of this curriculum was used as as dependent variable for the analyses

in this technical report. In addition we used the California Test of Basic Skills, the standardized achievement test used in the fall and spring in these California classrooms. The initial analysis of learning outcomes of the curriculum revealed that the math sub-test of the standardized achievement test was very sensitive to learning on this curriculum. This was because the math sub-test contained many items which were directly relevant to the content of the curriculum. When there were word problems, measurement problems, metric problems, or problems requiring mapping of coordinates, the students who had experienced the curriculum showed outstanding gains in comparison to children in comparable classrooms in these schools (De Avila, 1981).

Although we also had individual measures on language proficiency and intellectual development, early analysis showed that the single most powerful control for individual characteristics we could use in the analyses was the individual's pre-test score. Especially on the standardized achievement test the individual's test score was closely related to language proficiency, because these tests can only be taken in English. In contrast, the criterion referenced test was given in Spanish or English; it therefore did not relate as closely to language proficiency as did the standardized achievement test. For this and other reasons, the two tests related to process measures of learning in different ways. We therefore decided to retain the two different measures of learning outcome in the analyses that follow.

The content-referenced test was called the Science Mini-test. In the discussion and analysis below the standardized achievement test is broken down to the Math and Reading Sub-tests.For each of these three measures we had a pre and a post-test score.

Table 6 gives the average pre and post-test score on the above-described measures for each of the nine classrooms. There was important variation in the pre-test scores which by no means correlated with the care with which the curriculum was implemented.

INSERT TABLE 6 HERE

Strategy for Testing Hypotheses

Each hypothesis was tested at the individual and classroom level. The instruments just described provided equivalent measures at each level. For example, if we wanted an estimate of prescribed learning behaviors at the individual level, it was possible to look at frequencies for reading, writing, and talking/working together for each target child. If we wanted to look at this same variable at the classroom level, we could use the Whole Class Observation Instrument to calculate the proportion of all the students in the classroom for each observation who were engaged in reading, writing, talking and working together.

After creating various index scores, we were faced with the problem of aggregating across observations. There was a variable number of observations taken in the different classrooms. This was partly a product of problems of miscommunication between the classroom teacher and observer as to when the curriculum would be in operation and partly a product of the fact that some teachers implemented fewer weeks of the curriculum than others.

In addition to the problem of differing numbers of observations, there was the more fundamental issue of whether it was legitimate to aggregate across observations. If it were the case that there were more marked differences <u>within</u> observations made on the same classroom or child than <u>between</u> observations made on different classrooms or children, then it would not be legitimate to calculate mean values of the indices. If the sample of observations were not sufficiently large to produce stable estimates then it would be most unwise to aggregate.

In order to handle this problem we used a standard statistical procedure. An analysis of variance was carried out on the observations for each index. If "classroom" proved to be a significant source of variance(or "individual" in the case of target child data), then we concluded that it was permissible to calculate a mean value of observations for each index.

<u>Classroom Hypotheses.</u> After selecting suitable indicators of the three dimensions described above in the theor-

etical framework, each index was aggregated across time for a given classroom. With an N of only nine classrooms, we could not carry out overly elaborate correlational analyses. However, the classroom, as a unit of analysis, has considerable significance in this study because, as will be seen below, there was considerable variation in the implementation by classroom. Furthermore, the classrooms varied on the pre-test scores, so that it was critical to control on the pre-test score while examining the effect of implementation on the mean post-test score.

We use a method of partial correlations to solve these problems. The effect of the pre-test score (aggregated to the classroom level) is partialed out; we examine the partial correlations of the implementation measure of interest with the mean post-test score for the classroom. Implementation indicators are examined one at a time; then we combine dimensions to see if they behave in an additive fashion, so that implementation on two dimensions is more closely related to learning than implementation on a single dimension.

Individual Hypotheses. Testing hypotheses at the individual level is carried out on the sample of target children, where we have detailed behavioral measures of prescribed learning behavior and productive effort. Working at the individual level in an analysis of this type does not eliminate the need for significant contextual measures which reflect the effect of being in a particular classroom. For example a child might be productively engaged in the required

learning behavior every time we observed him, but if he were in a classroom where a teacher only got through half the curriculum, he would not have the same chance to learn the materials on the content-referenced test as a child who was in a classroom where the teacher got through the whole curriculum.

Multiple regression is the basic statistical technique at the individual level. Contextual variables such as weeks of the curriculum covered in the child's classroom or the level of differentiation are fed into the regression with the same variable for each child in a particular classroom. Before regressions are carried out, the intercorrelations of predictor variables are calculated so as to avoid problems of multicollinearity.

The data bank provides us with a number of excellent indices of prescribed learning behavior and productive effort on the part of individuals. For example we have available the observed rate of "off-task engagement" and the amount of written work on the worksheets. With an N of approximately 100 target children, we cannot use too many predictor variables at once. After examining the power of indicators from each of the theoretical dimensions, it is possible to characterize implementation more economically with the indicators we know to be significant predictors and which do not show too high a level of intercorrelation with other predictors. To test the first hypothesis on the impor-

tance of lateral relations, it is possible to focus mainly on the incidence of children talking and working together.

RESULTS

Overall Assesment of Effectiveness

In an earlier report to NIE, De Avila described the learning gains for the nine classrooms (Improving Cognition: A Multi-Cultural Approach ,February,1981). In this analysis students in the nine classrooms were compared to students of the same age and linguistic backgrounds who were attending the same or similar schools. The control schools were also involved with the Bilingual Consortium and had special aides and categorical aid funds. The comparison showed that students in participating classes showed better gains in reading and math, as measured by the CTBS. Students in the curriculum also made larger gains on the CTBS in comparison to the fall-spring gains of the norm group for the test.

There were also significant gains on the content-referenced test and in oral language proficiency. This analysis demonstrated the power of the curriculum to produce gains, not only in the areas where it was originally designed to produce learning, but in other areas as well. The curriculum appears to provide opportunities for improving literacy skills as well as opportunities to practice speaking English. Furthermore, the children who had shown lack of Eng-

lish proficiency at the beginning of the curriculum, benefited from the curriculum experience just as much as children who spoke English well.

The most important result, from the point of view of this report, was the analysis of the effect of classroom on the learning gains of individual children. In an analysis of each learning outcome, classroom remained a significant source of variance in learning outcomes. It is clear that although we are dealing with a powerful curriculum, there were major differences in the outcomes which could be attributed to the teacher and/or her level of implementation.

Implementation in the Nine Classrooms

This curriculum did not operate under "hothouse conditions." The original intention was to test its effectiveness under realistic organizational conditions where the project staff provided two levels of support. Neither level of support was beyond the financial reach of a district operating under normal conditions. In four of the classrooms the teacher and aide experienced only two days of workshop treatment prior to the beginning of the curriculum. The other five teachers had the same treatment just described; in addition they had two workshops which focussed, not on implementation of the curriculum, but on how the teacher and the aide worked together. This was an attempt to increase the reciprocal interdependence of the teacher-aide team.

These nine teachers were not specialists in science. They were volunteers who felt that they would like to learn how to teach science. They also felt strongly that language-minority students should have access to science. Science, at the time of the study, was omitted from the elementary curriculum for all intents and purposes in these classrooms largely made up of Mexican-American children.

Variation in Understanding

The first source of variation in implementation was the teacher and aide's understanding of the complex science activities at the multiple learning centers. A large part of the workshop was devoted to going through the same activities the children were to experience. However, there was no way that teachers could learn and remember so many different activities. It was necessary for each teacher to take the time to go over each activity and work it through before class. There were individual differences in how easy a task this was for the teacher; some were convinced that science was a frightening and difficult subject. A few proved to have a "flair" for science or an interest in the content of the activities. There were also individual differences in the willingness and motivation of the teachers to take the time to do this preparation. Some of them clearly opted to omit the preparation and were seen trying to figure out the instructions with the students during class time.

The aides were also invited to the workshop; they were encouraged to learn just as much about the nature of the activities as the teacher. However, some of the aides were unable to attend the initial workshops. Furthermore, as is typical of schools operating in this unstable period of funding, there were a number of switches in aide assignment, so that some trained aides were lost to the project after they were trained. This meant that the teacher had to train her own aide or assign only routine tasks to the aide which did not require an understanding of the activities. For example, an aide might be assigned to supervise activities which had potential danger to the students, like heating a raisin in a test tube.

Like the teachers, some of the aides acquired a good understanding of the activities and were able to give excellent assistance to the children. Others were never clear about the nature of the activities and/or were assigned tasks in the classroom which were routine and did not require this understanding.

The issue of understanding of the teacher and aide of how to do the activities was an important one. If an adult really knew what was supposed to happen in an activity they were able to provide assistance with only a few key words of advice or a well-timed question. If they didn't understand the activity, they would have to waste a lot of time puzzling it over with the children and often sending them off on false leads. Sometimes the children would decide that

they could do better on their own without an adult---which was probably an accurate evaluation of the situation.

Beyond the mechanics of understanding what was to be done at each learning center, there was variation in the teacher's understanding of the basic purpose of the activities. Several of them thought of the program as a general kind of enrichment or motivation for science. They missed the point of the underlying structure of the curriculum which was designed as a systematic approach to the development of thinking skills. This led to their hurrying through the curriculum, unsystematically omitting activities, especially toward the end.

Another kind of misunderstanding was the failure to grasp the open-ended character of the activities. They were designed so that children working at different levels of cognitive development could do the activities differently and still gain something from them. Furthermore, the very process of working things out for themselves was intended to be highly beneficial. Some of the teachers seemed to feel that there was one best way to do each activity----a "right answer" approach. These teachers tried to work with children in larger groups and ensure that they put the right answer down on their worksheets. Thus they attempted to standardize the learning experience in a way that was never intended by the developer.

In general, the origin of these problems was felt to lie in the lack of basic theoretical instruction in the ini-

tial workshops. We only had enough time to to get them operating in some practical sense and not enough time to give them a more fundamental understanding of the theory behind the curriculum.

Variation in Curriculum Coverage

A second issue in variation in implementation lay in how many weeks of the curriculum were covered. Several teachers found themselves at the end of the school year without having finished all 15 weeks of curriculum activity. One teacher only covered about six weeeks of the activity. She never seemed to find time in the day to do the curriculum. The observer would often go out to the classroom with the understanding that the curriculum would be in operation only to find out that it would not be taught that day. This happened with such annoying regularity that the staff began to wonder whether this teacher were actually hostile to the project. After some discussion with her and further observation of her classroom, we decided that she had fundamental problems in organizing her schedule and problems with managing the curriculum. Since she was unwilling to delegate authority, she only used a few centers at a time from the beginning. By the end,she had resorted to whole class instruction delegating authority to a few favorite students to help her supervise.In contrast, other teachers meticulously

and enthusiastically went through all 15 weeks of the curriculum.

Table 7 presents the number of weeks of the curriculum completed by each of the nine teachers. It should be noted that the concept "week" of the curriculum did not turn out to be necessarily the same as a calendar week. In constructing the curriculum, the learning centers were grouped by curriculum topic. We packaged activities and delivered them, defining a week's activities in terms of the recommended number of learning centers a child was to complete under a given curriculum topic. A curriculum week required twelve learning centers a week in the first part of the curriculum, but was reduced to six after Christmas. Individual teachers sometimes took more than a calendar week to get through a curriculum week.

INSERT TABLE 7 HERE

Variation in Staffing

A third issue in variation lay in changes in the teaching staff. In two classrooms, teachers left the school because of pregnancy. We had to train their replacement on an individual basis. When teachers were absent, the plight of a substitute who came in unprepared to deal with such a complex curriculum was often pitiable to observe.

Variation in Recommended Teaching Behaviors

We had specifically asked teachers to engage in behaviors which were new and different: in the workshop we had advised them to observe which children were not working at the activities at the cognitive level of which they were capable. We advised them to try to extend the activities for such children by asking questions. We actually provided them with questions in connection with each learning center which would provoke further inquiry by the children.

We also stressed to the teachers the importance of giving students specific feedback on their worksheets. However, as one might imagine, the teachers were just able to keep "their heads above the water" with facilitating all these new activities every week. Because the understanding and facilitating of the mechanics of the learning centers was a challenge of such great difficulty for most of them, they hardly seemed to have time to practice the recommended teaching behaviors, at least on this first attempt to teach the curriculum.

The systematic observations of teacher behavior revealed the failure of most of the teachers to practice the specific recommended behaviors. On the Teacher Behavior Instrument we counted the number of instances of teacher explaining, questioning and/or extending activities. These behaviors were totaled for each 15 minute period of observation and were called "teacher instruction" in the analysis.

We also counted the extent of feedback, which was defined as instances of discussion of specific strengths or weaknesses concerning either the students' (individual or group) performance on previous worksheets, the current worksheet, skills, general progress, or working together. For each type of teacher behavior, the total frequency was divided by the number of observations of that teacher so as to yield an average frequency per 15 minute period.Table 8 gives the results of this calculation for each teacher. For each type of instruction the average frequency and the standard deviation are included. The data are further divided by whether the teacher behavior was directed to individuals or to groups.

Apparently the teachers did not adopt the suggested roles. Even with a liberal definition of instruction (which included explaining), no teacher had an average rate of greater than 2.1 per 15 minute period of instruction to individuals. Instruction to groups was not that much more common. Four of the nine teachers had an average rate of less than one "instruct" to individuals per observation. The mean value for instruction for all teachers was 1.14 to individuals and 1.52 to groups.

Feedback varied between a low of 1.32 to individuals for one teacher to 5.90 for another teacher. The average rate of feedback to individuals for all teachers was 4.32; the mean rate to groups was 1.11.

INSERT TABLE 8 ABOUT HERE

Because of the low level of recommended behaviors on the part of teachers, we did not feel it was necessary to include the frequency of teacher behavior in relating implementation to learning outcomes. It is of course very interesting that the learning gains observed in this curriculum evidently did not require high levels of these teacher behaviors. We cannot tell what would have been the case if the teachers had done as we instructed. The learning outcomes might have been even stronger. In any case, this curriculum does not seem unusually dependent on the teacher managing all aspects of the recommended role shift.

Variation in Differentiation

In addition to these obviously important ways in which classrooms differed, implementation varied along the three dimensions conceptualized in the theoretical framework. We shall examine this variation in terms of the observation measures in the following sections.

Teachers clearly varied in the differentiation of the curriculum as measured by the number of different learning centers we found in use when observers visited the classroom. The first

TABLE 8

Frequency of Expected Teacher Implementation Behavior
To Individuals and Groups in the Class

(Mean Scores and Standard Deviations)

Teacher Number		INCIDENCE OF INSTRUCTION Mean	sd	INCIDENCE OF FEEDBACK TO STUDENTS Mean	sd	NO. of OBSERVATIONS n
1	To Individuals	.4	1.14	2.30	3.69	8
	To Groups	2.1	1.96	.50	1.41	
2	To Individuals	0.0	0.00	4.80	6.08	16
	To Groups	1.0	1.65	.06	.25	
3	To Individuals	0.6	1.02	1.90	2.39	15
	To Groups	1.4	1.86	.28	.70	
4	To Individuals	1.7	1.45	1.50	2.55	17
	To Groups	1.4	3.00	.41	1.70	
5	To Individuals	1.8	1.56	1.00	1.32	17
	To Groups	2.1	3.31	.06	.24	
6	To Individuals	1.7	1.86	2.00	2.32	11
	To Groups	.7	1.49	.36	1.21	
7	To Individuals	2.1	1.47	3.40	3.98	10
	To Groups	1.0	1.32	.12	.31	
8	To Individuals	.6	1.90	4.80	6.35	10
	To Groups	2.2	3.25	1.00	1.56	
9	To Individuals	1.1	1.53	5.90	6.81	9
	To Groups	2.4	1.94	.78	1.64	
Total Population						
	To Individuals	1.14	1.52	2.86	4.32	
	To Groups	1.52	2.39	.35	1.11	

week most of them started out with all the learning centers in action as they had been instructed. By the second week each one had reduced this number, but some far more than others. Even after Christmas, when we reduced the recommended number of learning centers to six, few classrooms implemented this recommendation literally.

There was a characteristic level of differentiation in each classroom which developed after the first week. An analysis of variance of the second through the last week of observations showed classsroom to be a significant source of variance in the number of learning centers in use ($F = 8.06$; $p<.001$). In other words, there was more variation between observations made on different classrooms than within observations made on the same classroom.

Table 9 shows the average number of learning centers in use in the nine classrooms starting with the second week of observation. Teacher #8, who finished the fewest weeks of the curriculum, had only 2.3 learning centers in use across observations, while Teacher #9, who completed the curriculum, had 6.9 learning centers in use, on the average. Teacher #1, who also completed the curriculum, only had an average of 4.1 learning centers in use. This teacher tended to use fewer centers at a time and to supervise larger groups in a direct manner. In order to complete the curriculum in this way, she gave it much more classroom time than any other teacher.

The issue of differentiation was closely linked to the issue of delegation of authority. Using more learning

centers at once, necessitated more delegation of authority to students. There were critical differences in the way the teacher played her role.

Some teachers tried to maintain a traditional role of giving direct instruction to larger groups, restricting the number of learning centers that could operate at once. Such a teacher would assign aides (sometimes two in a classroom) to cover the groups she could not personally supervise. Other teachers allowed the children to move from center to center on their own. The students had to take the responsibility for deciding when they were through with a given learning center and the responsibility for getting themselves through each center available for the week. The teacher would rapidly move about the classroom facilitating activities. She would focus in particular on children who appeared to be confused or wandering about. She would spot difficulties with the activities and try to "trouble shoot."

As constant visitors to these classrooms, we saw this variation in delegation to authority. The phenomenon had consequences for the observed number of learning centers in use and for the frequency of large student groups. Teachers whom we observed as trying to maintain routine bureaucratic supervision, actually had fewer learning centers in use and more frequently used large group instruction. This particular problem of the changed role for teachers required by a particular curriculum is one what has been described by Fullan as the most common problem in implementation (1980).

INSERT TABLE 9 HERE

Variation in Productivity

As a measure of productivity at the classroom level, we used the average number of worksheets completed by a child in the class over the course of the curriculum. Most of the activities required the student to fill out a worksheet in English or Spanish.

We asked the teacher to save these worksheets for project data. At the end of the curriculum, we collected them, and counted the number for each child and classroom. It should be noted that this is a good measure of productivity on the classroom level. Those classrooms with fewer numbers of worksheets were those classrooms completing fewer weeks of the curricula as well as those classrooms where teachers did not place much stress on completion of worksheets.

Teachers did vary in how much stress they put on the completion of worksheets. Some would demand a satisfactorily completed worksheet as a "ticket" to the next learning center. Others did not even have a systematic way of collecting or checking over worksheets. For still others, filling out worksheets became a supervised group activity instead of an individual activity where the student had major responsibility.

Returning to the classroom level, analysis of the number of worksheets per child per week revealed that classroom was a significant source of variance. This means that there was a characteristic level of worksheet productivity pertaining to the different classrooms. Table 9 gives the average figure for each of the nine classrooms.

There was a maximum of 160 worksheets provided to classrooms for each child to fill out. Not surprisingly, no classroom showed that level of productivity; some students were absent or much slower in completing activities than others, even if they were given access to all these worksheets. The variation in productivity was even greater than the degree of variation on the measure of differentiation.

Variation in Mediating Learning Behaviors

Table 9 also shows the percentage of children who were observed reading, writing, talking, and manipulating the materials. These measures come from the Whole Class Instrument. It will be recalled that this instrument classifies each child as to type of activity. It was administered twice for every classroom visit. If children were apparently working at learning centers, it was assumed that talking was task-related. It was not always easy to assess this with great certainty.

In order to construct the index of "average percentage of all children doing each activity for a classroom," the ba-

sic figure of an average percentage across all observations in a given classroom was weighted by the average number of children present in that classroom. This was done by dividing the average percentage in a given activity by the average number of students present over all observations in the classroom. This was then divided by the grand total of Ss involved in all activity modes, across all observations.

Analyses of variance were conducted on the percentage reading/writing and the percentage talking, week by week. These were the major categories used in the analysis. Classroom proved to be a significant source of variance for both these variables; for percentage reading, $F = 2.22$, $p < .05$; for percentage talking, $F = 3.79$, $p < .001$. In other words, there were levels of these activities which tended to be characteristic of the instruction of a given classroom. It was therefore legitimate to aggregate data across observations for each classroom.

Overall, the behavioral variables reveal that many classrooms were a ferment of activity stemming from the curriculum. This corresponds with the observation of any visitor or staff observer in these classrooms. Large proportions of the children were talking, manipulating, reading the instructions, or writing on the worksheets. Particular classrooms varied, both in the total proportions of children so engaged, and in the average percentage of children showing different learning behaviors. For example, teacher #9, who had such high levels of productivity, also had a high proportion

of the students engaged in recommended learning behaviors(73%); and a high degree of differentiation as well. At the other end of the spectrum, teacher #8, who had the lowest level of productivity and differentiation, also had the second lowest percentage of students engaged in the mediating learning process-- only 51% of her students, on the average, were seen engaged in the recommended behaviors.

Teacher #6, however, who had low productivity, had a high proportion of students engaged in recommended learning behaviors (73%); she showed a middling level of differentiation. Some classrooms were much more likely than others to have children talking. Three classrooms had approximately eleven to twelve percent of the children, on the average, reading and writing, contrasting with three classrooms where an average of only four percent and six percent of the children were seen reading and writing.

Hypothesis on Lateral Relations

The first hypothesis, it will be recalled, predicted a positive relationship between the frequency of lateral relations among students and the amount of learning. This relationship should hold under conditions of a high level of differentiation in the technology. Lateral relations between children represent a delegation of authority from the teacher, which according to sociologists who have studied technol-

ogy and work arrangements, should take care of the problems arising from a high level of differentiation.

Table 9 illustrated the fact that in all the classrooms we saw a relatively high level of differentiation. Rosenholtz examined the level of complexity of the technology observed during the curriculum and compared it to the complexity of the regular math periods. He found relatively few of our curricular sessions which employed whole class instruction. These typically took place when the teacher was trying to orient the whole class to a new batch of learning centers. Rosenholtz found only 13 of the FO/D observations which fell into his "Low Complexity" category (1981). We can therefore test the relationship in the hypothesis, using all the FO/D observations, under the general assumption that the curriculum did indeed represent a high level of actual differentiation in the classrooms.

The hypothesis concerning lateral relations can be tested at the classroom and at the individual level. Table 9 gives the average percentage of children observed talking and discussing with others for each classroom. This percentage ranged from 5% for Teacher #8 to 18% for Teacher #9.

In testing this hypothesis it is esssential to hold constant the average pre-test score on the learning measures for a given classroom. Table 6 showed the marked variation in the average values per classroom for these measures. There was the additional difficulty that in some of the classrooms with weaker implementation, the pre-test scores

were higher. Therefore, we partial out the average pre-test score and compute a partial correlation between the percentage talking and discussing and the mean post-test score. The N for this calculation is only nine, because the unit of analysis is the classroom.

The partial correlations of the percentage of the class observed talking or discussing with others with CTBS Math (the Total Score and the Application Subscale) and with the Content-Referenced Science Test are as follows:

CTBS Math Total------- .13;
CTBS Math Application Subscale--------- .21;
Content-Referenced Science Test-------- .64.

The partial correlation between talking and the Science Test is statistically significant at beyond the .05 level. This means that classrooms where a larger percentage of students were engaged in horizontal communication were classrooms which showed larger gains on the science test.

Let us turn now to the individual level and see if the relationship observed at the classroom level also holds for the sample of target children. Task-related talk to peers was a specific category in the Target Child Instrument. Analysis of variance showed a certain stability in the individual's child's rate of talking across observations; ($F=1.39$; $p < .009$).

The Target Child Instrument also contained a category called "Works Together with Others." Every time the observer saw this occur, s/he made a check on the scoring sheet. As with the rate of talking, child was a significant source of variance in the frequency of this behavior per observation; $F=1.28; p<.033$).

The frequency of interdependent relations in the context of the curriculum was very high. Overall the target child worked with another child an average of twice in a three minute period. Table 10 gives the average rates of these behaviors for target children in the classrooms of each of the nine teachers.

INSERT TABLE 10 HERE

Although interdependent work relations were common in all the classrooms, it is interesting to see that the lowest average rates occur in Teacher #1, #2, and #4's classroom. Both Teacher #1 and #2 had two aides and tried to use direct supervision wherever they could. As a result they cut down on the lateral relations between children.

The best measure of lateral relations between children is one which simultaneously takes into account task-related talk and working together. We created a special variable, called Talking and Working Together to capture the concept of lateral relations. This was done by multiplying the rate of student task talk per observation by the rate of observed

working together per observation. The unit of "task talk" was defined as an uninterrupted speech with the same partner. The total frequency of these speeches for all three minute observations was divided by the number of observations for that child. This average rate of talking was then multiplied by the average number of times we scored "working together" for the same child.

Table 11 presents the partial correlations of this variable with the Math achievement test total and the content-referenced science test scores. As in previous analyses, the pre-test score is partialed out. In addition to the Talking and Working Together Index, Table 11 presents the partial correlations for the two parts of this index separately: Talking alone and Working Together frequencies. Also included is the variable of Talking and Manipulating. This was scored when the target child was simultaneously talking about the task and handling the equipment at the learning center.

INSERT TABLE 11 HERE

The best measure of lateral relations, Talking and Working Together, has a significant partial correlation with the Science Mini-Test, .26, which is statistically significant beyond the .01 level. The simple rate of task-related talk bears a significant relationship to the overall math score, but the relationship to the science test is not sta-

tistically significant. Instead, the simple frequency of working together predicts the science test gains, but not the gains in the math test. Manipulating and Talking is significantly related to both test measures.

Overall, there is a strong relationship between these measures of communication and interdependence and test score gains. The target child measures show that for these children and with these more detailed measures, lateral relations are helpful for learning on the standardized achievement test as well as for the science test. In general, the results for the target child level parallel the results at the classroom level; lateral relations have the most significance for the content-referenced test, but some significance for the math test, as well. The first hypothesis has received support at the classroom and at the individual level of analysis. The signficance of this statement lies in the completely independent nature of these two sets of observations.

Learning as as Function of Implementation

We are now ready to turn to the test of the second hypothesis concerning the relationship between implementation and learning outcomes, using the three dimensions of implementation selected as having theoretical importance. Again, these rich data allow us to test this hypothesis at the

classroom and at the individual level. First, we test the hypothesis at the classroom level of analysis.

Implementation and Learning:Classroom Level

There are, in this analysis, three dimensions of implementation: Productivity, Differentiation, and Mediating Learning Process. Productivity is measured by the average number of worksheets per child in a classroom. Differentiation is measured by the average number of learning centers in use per observation in each classroom. The various dimensions of learning behavior are measured as described above, by the average proportion of students in the classroom who were seen engaged in prescribed learning behaviors.

Table 12 presents the zero order correlations among all implementation and outcome measures. The reader should keep in mind that relationships of implementation variables to outcome measures are affected by the pre-test scores(which are uncontrolled in this analysis) and by the small sample of 9 classrooms on which the correlations are computed. Also included in this table are several combinations of prescribed learning behavior and productivity : Reading/Writing & Worksheets; and Talk & Worksheets. These intercorrelations permit us to examine how well the three dimensions are related to each other. We can also see if all

the prescribed learning behaviors work in pretty much the same way in relating to productivity and differentiation.

The first thing to notice about Table 12 is the low level of relationship between the measure of differentiation and productivity (r = .07); these are independent dimensions. On the whole, there are modest positive correlations between productivity, differentiation, and the prescribed learning behaviors with one striking exception. The proportion of children manipulating the materials is negatively related to every other behavior (with the exception of talking); manipulation is also negatively related to productivity and differentiation. This finding was totally unexpected.

There are significant zero-order correlations between the number of worksheets and the post-test scores on the CTBS. This would suggest that those teachers who covered more of the curriculum, placing the recommended emphasis on worksheets had better results than those teachers who either omitted weeks of the curriculum or did not demand that the children complete their worksheets. The same is not true for the measure of differentiation. Of the various learning behaviors, reading/writing show significant positive correlations with CTBS math scores. Manipulation is significantly negatively related with all learning outcome measures.

The relationship of implementation to learning outcomes is quite different for the content- referenced science test than for the CTBS math test. For the science test, the only significant zero order correlation with implementation

is a negative relationship with percentage of students manipulating materials. There are other puzzling negative relationships between this test and the measures of implementation. Both the level of differentiation and the percentage of students reading/writing are negatively associated with post-test science outcomes. On the overall measure of implementation there is only a correlation of .10 with the science test

In contrast, for the CTBS math test, the correlation with the combined implementation index is .67, significant at the .05 level. The only strange relationship for this standardized test of achievement is with the percentage of students in the class manipulating materials---a negative relationship.

The two teachers with the weakest overall implementation happened to have the highest average pre-test scores. The correlation between the measure of differentiation and the pre-test was therefore -.52. The correlation between the proportion reading/writing and the pre-test score was -.19. Thus, it becomes critical to partial out the effects of the pre-test score in examining the impact of implementation on learning, especially on the science test.

It can also be argued that it is essential to partial out the effects of the pre-test scores on the CTBS. The strong observed correlations between percentage reading/writing and average number of worksheets and CTBS math could be an artifact of classes who know how to read and

write comparatively well and are therefore found filling out their worksheets and gaining higher scores, not because of the curriculum, but because they are more advanced academically in the first place.

In review, Table 12 demonstrates at least four points. First, it indicates that the dimensions of implementation are relatively independent of each other. Second, there are strong zero-order correlations betwen the CTBS math and the measures of productivity and reading/writing. Third, the percentage of students involved in manipulation of materials has quite a different relationship to other mediating learning variables and to outcome variables than was expected by the developer. This is why the combined index of implementation omits this variable for the time being. Fourth, of all the implementation variables, productivity is the most powerful predictor of learning outcomes. Producing more worksheets is associated with higher average scores on CTBS math.

TABLE 12 HERE

Table 13 compares the relative strength of the different dimensions of implementation in predicting the average post-tests score for the classroom, partialing out the effect of the average pre-test score. The relationship of productivity to the CTBS math test holds, although it is no longer statistically significant, once the pre-test score is controlled. The relationship of productivity to the science test

is now postive (.31), once the effects of the relation- ship of productivity to the pre-test score is partialed out.

Differentiation has a modest positive relationship to all learning outcome measures in this analysis. As for the behavioral variables, the strongest predictor of the math CTBS score is still the proportion reading/writing ($r = .57$). This behavior bears no relationship to the science test. In contrast, the percentage of the class observed talking shows a statistically significant relationship to the science test ($r = .64$). Manipulation continues to show negative relationships to the learning measures.

INSERT TABLE 13 HERE

The second section of the table takes two dimensions of implementation at a time to see if this increases the power to predict learning outcomes. When worksheets and reading/writing are combined as a single index, there is a statistically significant relationship to the average CTBS math scores. If talking is combined with worksheets, ability to predict math scores falls somewhat from that of productivity alone. The combination of productivity and differentiation gives a stronger coefficient for each of the learning outcome measures than that yielded by each of these dimensions individually.

When three dimensions are combined into an index, or when all variables are combined, the power to predict learning outcomes remains high for the CTBS, but not as high as the percentage talk-

ing, by iteslf, in predicting the content referenced test.

Discussion of these results will be postponed until after the hypotheses on implementation are repeated for the individual level. However, it is valuable to review the results that should be compared to the findings on the individual level. Productivity, as measured by the average number of worksheets per child in a classroom has powerful relationships to learning outcomes. Observed reading and writing seems to be more powerfully connected to the standardized math scores than to the science mini-test. The percentage talking is the most powerful predictor of the science mini-test.

The three dimensions of implementation are not correlated at the classroom level. Differentiation only has a modest positive relationship to learning outcomes. It does have the efect of boosting the power of productivity (worksheets) to predict all learning measures. Similarly, one can boost the power of productivity to predict math gains with the proportion reading/ writing, but productivity combined with proportion talking is inferior to the simple proportion talking in predicting science test gains.

Implementation and Learning:Individual Level

At the individual level the data are taken from the target children, whom we observed weekly for three minute intervals. These data on the behavior of individuals are combined with a contextual variable representing the instructional organization of the classroom. One cannot analyze data on children as if they were operating in a vacuum; their behavior will be very much affected by the task organization of their classroom.

Effect of Productivity and Classroom Differentiation.

The best measure of productivity at the individual level is the child's engagement with the task. This is also a concept which has the advantage of wide use in contemporary classroom research. In the Target Child Instrument, every time the child was clearly "off-task," the observer made a check mark. The definition of "off-task" in the context of this curriculum did not include behaviors such as watching others or behavior that might indicate thinking about the task. The whole concept of disengagement, it seemed to us, was relative to the demands of the task. A rigid definition of engagement such as "eyes front,", or working with instructional materials, seemed quite inappropriate for this situation. If the child were moving about or engaged playfully with classmates, did the observer check "off-task."

In developing a rate for "off-task" behavior, we counted the proportion of all recorded behaviors that were in the "off-task" category. We chose to do this rather than a straight frequency count because of the character of the scoring system. If a child rapidly alternated between being on and off task, s/he might acumulate more "off-task" scores than a child who was continually off-task for the observation period. By creating an index of the proportion of all behaviors which were "off-task," we could derive a rate for "off-task" behavior for the three-minute period. Translating the proportion into a "rate" assumes that each recorded behavior took approximately the same number of seconds.

In order to calculate a rate of "off-task" behavior across observations for a particular child, we carried out an analysis of variance to find out if there were rates which were characteristic of particular children over the weeks of observation. The child proved to be a significant source of variance in the observed rates ($F=1.68; p<.001$). It was then legitimate to create a mean "off-task" behavior rate for each target child by adding the rates for each observation and dividing by the total number of observations. In the following discussion of results, we shall call this statistic the mean rate of disengagement. It should, of course, have a negative relationship to learning.

The frequency distribution of rates of disengagement for the target children was skewed toward the low end of disengagement. Table 14 groups this distribution into six inter-

vals based on natural breaking points in the frequency distribution. This curriculum was obviously a highly engaging one. Fully 19% of the target children were never seen disengaged in all the weeks of observation. Forty-eight per cent were disengaged less than 11% of the time. Only 6% were disengaged, on the average, for more than a third of the time.

This finding is especially significant in view of the fact that the sample of target children included those seen as especially problematic by their teachers and children who had little proficiency in English or Spanish.

From a statistical point of view the fact that this is not a normal distribution is undesirable for regression analysis. However, in accord with common practice in the field, we decided to use it anyway, keeping in mind the limitations of the measure and relying on examination of other measures of productivity to back up any results with this particular behavioral indicator.

INSERT TABLE 14 HERE

In designing a regression equation to test the impact of disengagement on learning, the measure of differentiation at the classroom level was inserted as a contextual variable. The classroom measure of the average number of learning centers in use was utilized as the measure of differentiation. Clearly an individual's level of engagement must be partly a function of the range of options of tasks

s/he might be carrying out; in this case the number of useable learning centers is a good representation of the organization of the classroom. Each child in a classroom was assigned the same value of the differentiation variable.

The average number of learning centers in use in a classroom is negatively correlated with a child's rate of disengagement ($r = -.22; p<.05$). This correlation along with all the other zero order correlations of the implementation and outcome measures at the individual level may be seen in Table 15. Unlike the classroom level analysis, this analysis finds a positive relationship between the two dimensions of productivity and differentiation. There are several good reasons why this might be the case. In the first place, the behavioral measure is much closer in time to the learning center usage than the worksheet measure used at the classroom level. When there are more learning centers in use, a child literally has more things available to do to keep himself busy. In the second place, more learning centers in use means that there are more small groups scattered about the classroom. Small groups has repeatedly been found to produce high levels of engagement in previous research (Berliner et al,1978; Hess & Takanishi-Knowles,1973; Ahmadjian,1980)

Although the observed level of association is not very high, the problem of multicollinearity must be kept in mind when examining regression results. We chose to use step-wise regressions on the learning outcome measures. The pre-test scores were stepped in first, followed by the contextual var-

iable of number of learning centers in use. The measure of productivity was stepped in last even though the problem of multicollinearity put it at some "disadvantage" in competition with differentiation and in competition with the pre-test score on CTBS Reading. Table 15 shows that there is also a significant negative correlation between disengagement and the pre-test score on the reading test. Poor readers are rather notorious in classrooms for their level of disengagement.

INSERT TABLE 15 HERE

The order of the predictors in the regression was dictated by theoretical considerations. It seemed to us that the impact of individual disengagement should be examined in light of the contextual situation as well as in light of the individual's starting point on the test score. We have included the summary of R^2 for each regression equation with the first, second, and third predictor variables stepped in.

Learning outcome measures for the individual level analysis included the total score on the standardized reading test as well as the math test(CTBS). Since preliminary analysis of learning outcomes showed strong gains in reading for the children who experienced the curriculum, it was of especial interest to link these gains with behavioral measures of implementation. The third measure of learning was the content-referenced test, called the Science Mini-Test.

All three measures show very high intercorrelations at the two points in time. Even the Science Mini-test is highly correlated with the reading test, despite the fact that the Science Mini-test was read out loud to the children in English and Spanish. These intercorrelations may be seen in Table 15. The very high level of correlation, especially for the reading test, between scores taken at two points in time, means that the implementation measures must make a contribution to explaining the variance, over and above the large amount of variance that is accounted for by the individual's pre-test score.

Table 16 gives the results of the regression equations on disengagement and differentiation. Despite the unfavorable position of disengagement with respect to the order of the predictors in the regression, disengagement is negatively related to learning outcomes for all three measures. It produces beta weights with statistically significant F values. Of course the amount of variance it accounts for in the learning measures is very small in comparison to the impact of the individual's pre-test score. The reading pre-test score accounts for 71% of the variance in the post-test score--- a "lion's share" of the variance. Disengagement can only account for 1% of the variance in addition to what has already been acounted for by the pre-test score and the number of learning centers in use. Disengagement accounts for 6% of the variance, uniquely, in the equa-

tion on the math test, and 2% of variance on the Science Mini-test.

INSERT TABLE 16 HERE

Differentiation is not, by itself, a significant predictor of gains on the Science Mini-Test. This is parallel to the finding at the whole class level. Differentiation, does, however, have a statistically significant beta weight in the equation for the reading test. Finally, it should be noted that in the case of each measure of learning, entering the value of both the productivity and differentiation measure accounts for more variance than differentiation alone.

Effect of Learning Behaviors:Individual Level. At the individual level the two most relevant behaviors to examine are the frequency of reading or writing and the rate of talking and working together. These are the variables which appeared to be important at the classroom level. From a theoretical point of view, we already know that working together and talking are important from the analysis of the impact of lateral relations on learning. The significance of observed practice in reading and writing as a predictor of gains on standardized achievement tests is particularly great because of the fact that this "practice" took place in a functional context of the child solving a problem. It did not take place in the context of the reading group or other

drill, recitation or seatwork exercises, so common in today's classrooms.

The index of reading/writing was a simple frequency count taken for each target child observation. On the front of the scoring sheet the observer checked off whether or not the child was seen reading or writing at any time during the three minute observation. Thus the score could only be zero or one for each observation. The total frequency was divided by the number of observations to yield an average number of times the child was seen reading or writing.

The index of talking/working together was described in the section on lateral relations. It is simply the product of the rate of talking about the task and the rate of working with peers averaged across observations.

The intercorrelations of all the variables used in the next set of regression equations are shown in Table 15. Note that the two behavioral measures of reading/ writing and talking/working together are unrelated to each other. Reading/writing shows a statistically significant relationship to the math and reading achievement post-test scores. Talking/working together is significantly correlated with post-test scores on the math and science tests.

Note also that talking/working together is significantly correlated with the pre-test score on the math test. This suggests that children who were advanced in mathematics achievement may have been viewed as a valuable resource in

the interaction of the classroom. In connection with another secondary analysis of these data, we have shown that children who are chosen as good readers in these classrooms were more likely to be talking and working together. From a statistical point of view, this means that the impact of talking and working together on math post-test scores faces competition from the pre-test score. In the previous section on lateral relations, we did see that talking/working together no longer had a significant correlation with the post-test score, once the effect of the pre-test score was partialed out.

The number of learning centers in use is correlated with talking and working together ($r=.23;p<.05$). Unlike at the classroom level, differentiation is related to the measure of mediating learning process. As described above, the presence of more learning centers in action means that there are more small groups where children are likely to talk and work together. Again, this relationship presents a problem of multicollinearity in a regression where both differentiation and this behavioral variable are present.

The same procedure was used for this series of regressions as the last. The pre-test score was stepped in first; then the measure of differentiation; and finally the measures of mediating learning behavior. Table 17 presents the beta weights for these predictors and the R^2 for each regression equation.

INSERT TABLE 17 HERE

The observed frequency of reading or writing is a significant predictor of gains on all learning outcomes. The rate of talking and working together has a significant beta weight for gains in the Science Mini-test, but not for the standardized achievement test. These results parallel the results found at the classroom level. It may be the case that lateral relations are also important for gains in the math test, but the problem of multicollinearity may obscure the relationship. It will be recalled that the rate of talking, by itself, did predict post-test math scores when pre-test scores were held constant.

The problems of multicollinearity are such that one cannot use indicators of disengagement along with these behavioral measures in the same regression equation. In the scoring system, if a target child were not reading or writing or talking, s/he was likely to be disengaged. This is shown by the strong negative correlation between each behavioral measure and disengagement (See Table 15).

<u>Effect of Worksheets on Learning</u> It will be recalled that the average number of worksheets per child, as a measure of productivity at the classroom level, proved to be a powerful predictor of learning. However, we were unable to use number of worksheets per individual child as a measure

of individual productivity because of missing data and other problems. In a special contract with the state of California, the available worksheets for the target children were carefully scored on a number of dimensions for the quality of performance (DeAvila & Cohen,1981)

The measure most closely related to productivity was a count of the amount drawn and written on each week's worksheets in response to the questions requiring the student to describe procedures and results of their activities. This measure of effort and productivity showed gains over the weeks of the curriculum. Furthermore, when the scores were averaged, and the effect of the pre-test score partialed out, there were significant partial correlations between the amount written and drawn on the worksheets and gains on the standardized achievement test and on the Science Mini-test. Furthermore, other measures of the goodness of the inferences the child made on the worksheets, the quality of the sentence structure, and the correctness of the computations were also significantly related to gains in all test scores, using partial correlations.

Parallel to the finding for classrooms, worksheets are also important for learning at the individual level. The fact that reading/writing predicts gains on the Science Mini-test means that the worksheets were important. The thoroughness and correctness with which these worksheets were filled out was strongly related to doing well on the

content-referenced test. This aspect of implementation proved to be quite critical to good results.

We did attempt some regression equations where reading/writing and working/talking together were stepped in along with the amount written and drawn, as a measure of productivity. However, the worksheet measure did not prove to have a significant beta weight in this context.

This finding raises an interesting problem of the limits of regression analysis for our purposes. Regression treats all these variables as if they were occurring at the same point in a process, but actually, they are better thought of as taking place at three stages. The student's prior level of achievement and the task organization of the classroom set the stage. Next comes the learning behavior which is aimed at the production of worksheets. As a product of this effort comes the quality and quantity of performance on the worksheets. In future analyses, a path model may turn out to be the best way to characterize these data.

DISCUSSION

Review of Major Results

Variation in Implementation

There was considerable variation in the way this curriculum was implemented in the nine classrooms. Teachers clearly could not manage the level of differentiation (12 learning centers per week) that was originally envisioned by the developer. Even after the recommended number was cut to six, the observed number of learning centers in simultaneous operation suggests that many rooms operated with fewer than six at a time. Nonetheless, the observed level of differentiation was markedly higher than that in the math classes of the same teachers (Rosenholtz,1981).

There was also marked variation in the amount of talking and working together among the children. Some teachers were much better able to delegate authority to children to assist each other and to take responsibility for solving the problems of the curriculum and moving through the learning centers than others. Some tried to use their aides to maintain as much direct supervision as possible using somewhat larger groups of children.

There was also marked variation in the stress placed on completing the worksheets in the curriculum. Some teachers did not complete the curriculum. Others completed the curric-

ulum but did not place much stress on filling out and turning in the worksheets.

Implementation of Teacher Role

In the three day workshop, teachers were instructed in how to make some decisions about special attention certain children would need. This was an aspect of the curriculum requiring non-routine decision-making on the part of the teacher. She was to extend activities of children who were capable of carrying out the tasks at a higher level. She was to give specific constructive feedback, based on the actual worksheet performance of individual students.

Analysis of the data on teachers showed that there was very little of this type of behavior on the part of teachers. They were very busy trying to keep the children correctly oriented to the challenging activities. They found the tasks very challenging themselves and were often only one step ahead of their classes.

Classroom Processes and Learning Gains

There were strong overall learning gains among the children, not only on the substance of the curriculum, but on the skills measured by standardized achievement tests. Analysis of these gains by DeAvila showed that there were also gains in cognitive development and gains in English pro-

ficiency among those children who were not proficient in the fall (De Avila,1981). In this analysis we were able to link gains to specific aspects of classroom processes.

Analysis of gains on the content-referenced science test showed links between learning and talking and working together as well as links between learning and reading and writing. Furthermore, working out the problems on the worksheets was linked to gains on this test. In all these analyses, the effect of pre-test score was held constant.

Analysis of gains on the standardized math test showed correlations between reading and writing in the context of the curriculum and post-test score. Also predictive of math score gains were correct computations on the worksheets and the drawing of correct inferences. Furthermore the sheer number of worksheets completed in a classroom predicted average classroom improvement on the math test.

Lastly, analysis of gains on the standardized reading test at the individual level showed that reading and writing in the context of the activities were predictive of improved scores. Also, the more learning centers that were available to the child, the greater were his/her gains. Finally, the quality of the writing on the worksheets was predictive of gains on the reading test.

Lateral Relations

It was hypothesized that given the level of complexity of this curriculum, interdependent relations among the students would reduce task uncertainty and would therefore lead to more learning. There was good support for this hypothesis in the relationships between the proportion of students who were seen talking and average classroom gains on the Science Mini-test. At the individual level the rate of talking and working together among the target children was predictive of gains on the Mini-test. There were also some significant relationships between the talking among the target children and their gains on the standardized math test.

Dimensions of Implementation

It was hypothesized that each of three dimensions of implementation would be predictive of learning outcomes: Differentiation of the technology; Productivity; and Mediating Learning Process. There were independent measures taken of these dimensions at the classroom level and at the level of individual target children. Results showed links to different learning outcomes for the different dimensions. However, the basic results at the classroom and individual levels were similar.

Productivity, as measured by the average number of worksheets per child in a classroom, showed positive but not statistically significant relationships to the average gains on the CTBS math test at the classroom level. The relation-

ship was also positive but weaker for the Science Mini-test. At the individual level, productivity, as measured by disengagement among the target children, was a significant predictor of all learning outcome measures, holding constant pre-test scores. Finally, productivity, as measured by the amount written and drawn on the worksheets, showed significant partial correlations with the post-test scores of the math test and the Science Mini-Test, with the pre-test score partialed out.

Of the major variables prescribed by the developer as important for learning, reading and writing were strong predictors of gains on the math test at the individual and classroom level. The frequency of reading and writing among target chldren was a signficant predictor of gains on the Mini-Test and CTBS Reading test, holding constant the pre-test score. The second important mediating behavior was talking or talking and working together. This behavior showed strong links to learning gains on the science test at the classroom and the individual level. Manipulation without talking showed negative relations to learning at the classroom level, but not at the individual level.

Differentiation, the third dimension, did not show strong direct relationships to the learning measures. Instead it appeared to interact with the other dimensions. For example, when the proportion of students in classroom reading or writing was considered jointly with the level of differentiation, the power to predict learning gains on the

math test was greater than when either dimension was considered separately. Similarly, when the number of worksheets was considered jointly with differentiation, the power to predict gains for the math test in a classroom was improved over either dimension separately. Only for reading, at the target child level, did differentiation appear as a significant predictor in the regression equation.

Differentiation was correlated with the number of weeks of the science curriculum the teacher completed; it thus had an indirect link to the average number of worksheets turned out per child because if the curriculum were not completed, the child had access to fewer worksheets. At the individual level, it was also linked to talking and working together, so that target children were more likely to be found talking and working together in classrooms where there were more learning centers in use.

Importance of the Teacher

The first issue to be discussed is the significance of the teachers' failure to carry out recommended teaching behaviors. Does this mean that the learning gains were achieved without benefit of the teachers' efforts and skill? It is clear that much of the success of the students was not dependent on what the teacher said in the way of feedback and on various kinds of individualized instruction. However, these task instructions were very carefully prepared and had

been rather well pre-tested on migrant labor children in New Mexico. Many of the tasks had a way of providing instant feedback to the student---it either "worked" or it didn't. Furthermore the peers gave much feedback to each other while working on the tasks side by side or interdependently. Lastly, the curriculum had redundancy in the multiple activities; many of them taught the same underlying idea but in a very different media and mode. Thus if the child didn't understand one activity, he might pick up the idea with the next learning center teaching the same concept. Under these conditions of a carefully conceived and engineered curriculum, one might indeed conclude that the success of the curriculum was not as dependent on the teacher as is the case with more conventional curricula.

However, it would be a great mistake to conclude that the teacher was unimportant to the running of this curriculum. She had a critical role to play in orienting the children to the learning centers, in setting up working relations between the children, in getting the children moving around between learning centers, and in seeing to it that worksheets were completed and completed fully. This was more of a managerial than a direct instructional role. Some of our teachers managed it much better than others.

In this year's contract we did not analyze the data on coordination and control strategies of the teacher; that task remains for next year. However, the findings on the importance of worksheets and lateral relations suggest the cri-

tical importance of the coordination and control functions of the teacher.

One final point is in order. If we were able to help teachers more effectively in implementing the recommended behaviors, it might still be the case that the learning outcomes would be superior to what was found in this study. Thus the significance of these particular behaviors is still unknown.

Lateral Relations and Learning

The second issue for discussion is the way in which lateral relations led to superior learning outcomes on the content-referenced test. According to organizational sociology, interdependence among the workers under conditions of complexity reduces task uncertainty. This was almost certainly the case for children trying to find their way through a novel set of instructions at the learning centers. The tasks were thoroughly challenging to adult or child. For many of the target children, there was additional uncertainty stemming from their inability to read very well or to write the answers to questions on the worksheets. There were also a number of children in the target child sample who had limited proficiency in both English and Spanish. These children would need access to both languages in order to decode what they were expected to do. For these children, peers repre-

sented a valuable resource in finding out what they were supposed to be doing. Without this help they might very well have missed the benefit of the learning center activities. Clearly the adults could not be everywhere at once giving individualized assistance.

Lateral relations may have fulfilled multiple functions in learning the math and science concepts in the curriculum. In addition to reducing task uncertainty as described above, it probably gave the children the opportunity to practice all the new scientific vocabulary out loud, thus committing the words to working memory. There were many vocabulary items on the Science Mini-test. Students were also heard to give very fine explanations to each other, no doubt improving the understanding of the explainer as well as the "explainee." Many times, the group would brainstorm their way through to the solution of a mechanical or intellectual problem.

The very act of talking with each other about the tasks is of critical benefit to children who show limited proficiency in oral language. The children who were limited in both English and Spanish proficiency learned just as rapidly as their classmates in this bilingual curriculum. They were scored as talking quite frequently in English; and their English proficiency improved as a consequence of their experience. Conventional classrooms, even those classrooms specializing in English as a Second Language, rarely give much time to peer talk about work. These classrooms contained many pro-

ficient English speakers, so children with limited English proficiency had access to peers who spoke standard English. At the same time they had lingustic access to the curriculum through the bilingual curricular material and through the teachers and aides who were found to use both English and Spanish (De Avila and Cohen,1981).

A final function of lateral relations is the improvement of the engagement of the students. Talking and working together was strongly related to engagement among the target children. There was a very high overall level of engagement in this curricular setting. When children are not expected to sit quietly, but are permitted a more active mode of learning which involves talking to small groups of peers, the engagement level will be very high. This, in turn, has a favorable impact on learning.

Gains in CTBS

This curriculum was not originally designed to produce gains in reading and computation. The curriculum content does have direct relevance to general concepts included in the applications section of the math CTBS. In addition, the worksheet problems frequently asked the student to set up the computation, much as a standard word problem does. In the early versions of this curriculum, tested on children of migrant labor in New Mexico, gains in standardized achieve-

ment tests were first noted. We included these tests as part of our battery to see if these gains would be repeated.

The findings on these tests clearly suggest that the curriculum provides ample practice in reading, writing, and computing. Furthermore, this practice appears to have a "pay-off" in gains on the CTBS measures. The significance of this finding is far deeper than the common research result that active practice and active learning time yields test score gains. In this case, the practice did not take the shape of small group work with the teacher, or seatwork, or drill. Rather it took place in a peer setting, where children could and did ask each other to read for them and to tell them what to put down on the worksheet. Furthermore, when they did read and write, it was in the context of carrying out an intrinsically interesting task, not as an empty exercise. There was little evidence of direct instruction or feedback on any skill during this curriculum.
In other words, this was an alternative to direct instruction which still yielded a high level of active learning time, <u>simultaneously producing gains in thinking skills in the math/science area</u>.

The children in these schools were part of a special bilingual program which provided teacher aides, special workshops for teachers, strong emphasis on reading and math classes and considerable testing of the attainment of teaching objectives. In other words, much of their regular program took the form of compensatory education. In the early analys-

is of learning outcomes, DeAvila found that the children who had experienced FO/D showed superior test score gains to other children of the same grade experiencing the same compensatory programs.(DeAvila,1981).

Rosenholtz observed the math classes of a sub-sample of target children; these were the same teachers who taught our curriculum. He found ability groups under close supervision, receiving far more emphasis on routine computation than on the conceptual side of the mathematics curriculum (Rosenholtz,1981). These observations suggest that there were at least two sources of the superior math scores of children in FO/D. One was the active method by which concepts were taught at the learning centers in comparison to a tendency to neglect this side of the curriculum in math classes. The other source was undoubtedly all the extra practice in reading, writing and computation provided by the worksheets and instructions themselves. CTBS is administerd only in English and does require reading skills as well as math skills.

A most interesting finding was that the more different learning centers we saw in use, the higher were the gains in the target child's reading scores. Evidently, the more instructions and worksheets they grappled with, the better it was for their reading skills.

Currently, much is heard about the benefits of direct instruction for children who are working below grade level in academic skills (although exactly what is meant by "di-

rect instruction" is not always clear). These results run counter to any conceivable definition of direct instruction. Here are children who operate well below the state testing norms, making sharp gains in a classroom which is not organized for direct instruction at all. Instead, there are multiple tasks with multiple groupings of children functioning as interacting pairs and small groups, taking responsibility for their own learning. The gains on the standardized achievement tests are a by-product gained at the same time that the children are developing more abstract thinking skills.

However, these gains do not occur by magic. It is essential for an educator who wants to learn from the results of this curriculum to realize that this is a very carefully prepared curriculum. The instructions are detailed and clear; they are presented in English, Spanish and pictographs. There are carefully designed worksheets in English and Spanish available for almost every learning center. All the materials for the activities were boxed for each learning center, so the children or teacher had only to open up the box and "set up shop." The activities had been pre-tested; they had very high intrinsic interest and did not require a middle class set of experiences to understand. The children were told that it was legitimate to use each other as resources. Finally, this was not an "open classroom." Children were clearly told that they were to complete each learning center and worksheet.

Impact of Differentiation

In many ways the results on the number of learning centers in use (the measure of differentiation of the curriculum) are the most difficult to interpret. It helps to remember that all but thirteen of the FO/D observations fell into a "high complexity" category developed by Rosenholtz(1981). Thus when one looks at the results of variation in differentiation, one is looking at differences of degree, given quite a high level of differentiation to start with. Even so, it was originally assumed that the more different activities the students experienced, the more they would gain on the content-referenced test. This was really not the case. It is not clear that the level of complexity orignally mandated by the curriculum would produce markedly better results than we achieved.

Some of the failure of the measure of differentiation to have a direct impact on learning can be explained from the intimate knowledge we gained of how different teachers operated. One teacher had a low level of differentiation at any one time, but got through more worksheets than anyone else by giving the curriculum extra time and by seeing to it that everyone finished their worksheets. Another teacher had a high level of differentiation, but inadequate control of the worksheet production, thereby lowering productivity. This kind of observation suggests why it is that differentiation does not produce gains by itself. Differentiation

does not tell enough about the control system in the classroom. One has to consider worksheet production and differentiation simultaneously to arrive at a set of sufficient conditions for benefiting from the curriculum.

Differentiation also has to be considered simultaneously with lateral relations. There were teachers who went through the curriculum in a relatively mechanical way without sufficient attention to the process of talking and working together. It may be the case that unless differentiation resulted in small groups who talked and worked together, one does not see the benefit of different learning activities. Perhaps teachers who managed lateral relations particularly well, produced understanding of the basic concepts of the curriculum with fewer activities. This interpretation is supported by the finding that classrooms where larger proportions of students were manipulating the materials without talking did more poorly on tests than rooms where more talking was taking place. Classes with large percentages of children manipulating the materials may well have been classes where the children did not understand too much of what they were doing and were not using their peers to find out. In this case differentiation would benefit the class very little.

There are two implications of this discussion of differentiation. One is that further data analysis will have to move beyond the limitations of the regression technique to something like path analysis, where we can test out these

more complex notions of alternative ways to achieve gains on the science test, notions that involve stages over time from differentiation, through the mediating learning process, to the production of worksheets.

The other implication is for the curriculum itself. This curriculum could probably achieve excellent results without forcing the teachers to maintain anywhere near the level of differentiation originally envisioned. As a matter of fact, if teachers really did try to have 12 learning centers function simultaneously in classes of 28-30 children, they might well have had a low level of lateral relations because too few children would be at each center. This was probably an inheritance of the original setting of this curriculum in New Mexico where much larger groups of children were taught simultaneously. It will be necessary for the developer of this curriculum to consider which activities might be dropped and what core should be retained so as to keep the important feature of redundancy of major concepts while lessening the managerial burden on the teacher.

The exercise of trying to understand the impact of differentiation leads to a set of principles for working with teachers of this curriculum. In a way, the issue of differentiation is probably one of efficiency. If the teacher has good lateral relations and six or seven learning centers operating, along with tight control of worksheet production, she could get excellent results in a shorter amount of class time spent on the curriculum. Teacher #9 is an excel-

lent example of the benefits of this approach. If the teacher tries to maintain more direct supervision, while maximizing worksheet production, then she is going to have to spend much more time working with a lower level of differentiation. She will face the additional drawback of having sacrificed lateral relations to direct supervision. We will understand more about these strategies of direct supervision vs. delegation as a result of next year's analysis.

Engagement and Learning

This model of classroom organization produces very high levels of engagement among language minority children. It would undoubtedly be successful in other academically heterogenous settings. It is,however, critical to remember that this engagement was predicated upon full access to both languages, along with access to English speaking children. With this proviso, the general model of classroom organization represents a challenging alternative to individualization in dealing with academically heterogenous classrooms. It did not have the difficulties of elaborate diagnosis and prescription, nor the burden of elaborate record keeping teachers find so objectionable. Nor does it run the risk of degenerating into nothing more than individualized seatwork. The adjustment to individual need comes from the open character of the tasks, which can be done in different ways by differ-

ent children, and from the access to many different resources for assistance.

It does require a very carefully prepared curriculum with tasks designed to be carried out at different levels of cognitive development. Without special training in the underlying developmental theory, it is difficult to imagine the typically trained teacher creating such a curriculum.

It also requires the teacher to delegate authority to the learner to complete the tasks and to delegate authority to lateral relations. Rosenholtz found that under conditions of high complexity, the use of lateral relations was an important precondition for a high level of task engagement(1981).

SUMMARY AND CONCLUSIONS

We have reported the analysis of data on implementation of a complex curriculum and a battery of learning measures. The curriculum, Finding Out/Descrubrimiento, was designed to teach thinking skills to language minority children by E. D- Avila. There were 170 different activities in math/science to be used over 14 weeks. With the use of learning centers, twelve activities were planned per week. The activities were designed to teach thinking skills rather than facts of science or routine arithmetic operations. Using developmental principles, DeAvila selected those activities which could be carried out by children operating on different developmental levels. The student who completes the curriculum has many opportunities to work with the same basic concepts; the activities vary the media and mode, but systematically repeat the same underlying concepts. All instructional materials are prepared in English, Spanish and pictographs.

Nine bilingual classrooms, grades two through four, participated in the project; there were 307 children and nine teacher-aide teams. The schools were located in five districts in the San Jose area. Teachers and aides experienced a three day workshop, training them in the use of the curriculum activities and in the recommended classroom management techniques. There was one follow-up workshop in mid-year.

The classes were made up largely of children of Hispanic background with a small proportion of Anglos, Blacks and Asians. Parental background was working class and lower white collar. There were a few children from welfare families. Children had varying levels of language proficiency in English and Spanish.

This curriculum required a decentralized classroom organization. There were multiple learning centers operating simultaneously. Each center had different activities with different materials and worksheets. Children had to take responsibility to progress through each learning center and fill out the worksheet for that center's task. Teachers were instructed to legitimize peer work relationships by telling the children that they had the right to ask anyone else at their center for assistance and the duty to assist anyone who asked for help. Groups working at each center were heterogenous academically and linguistically.

This was not a demonstration project where extensive funds were invested in teacher preparation or in the hiring of master teachers. Instead these were teachers who wanted to learn about the teaching of elementary science and who felt that language minority children should have access to science materials. At the time this curriculum was implemented, science was, for all practical purposes, missing from the curriculum of the schools that were in the study.

In addition to an extensive battery of pre and post-test measures of learning, the data bank included detailed measures of classroom organization, teacher behavior and observed learning behavior of a sub-sample of target children. These instruments were designed to measure relevant sociological features of the classroom as well as specific features of this curriculum. The instruments were developed by Cohen and Intili out of their years of work with the Environment for Teaching Program at Stanford.

Students who participated in the curriculum showed significant gains on CTBS math and reading tests, a test of cognitive development, a test of oral English proficiency, as well as on the content-referenced test developed for this curriculum. Beyond these overall learning outcomes, the analysis in this report linked specific gains on learning measures to observed behavior and written performance during the weeks of the curriculum. The following were the major results:

1. Talking and working together was a predictor of gains on the content-referenced test, both at the overall classroom level and for the sample of target children.

2. Reading and writing behavior was a predictor of gains on the CTBS tests, math and reading, both at the classroom level and for the sample of target children.

3.The quality of performance on the worksheets was a predictor of gains on standardized tests and on the content-referenced test.

4. The level of engagement on the task was unusually high; 19% of the target children were never seen off-task; only 6% were found to be disengaged more than 30% of the time. Nevertheless, disengagement was negatively related to gains on all test measures.

All these analyses were carried out with correlational techniques in which the effects of the pre-test scores for classrooms and individuals were held constant when measuring the effect of a process variable on learning outcomes.

A Sociological View of Student Interaction

Several sociological hypotheses were tested in these data. Classroom organization was conceptualized as work arrangements and instruction was conceptualized as technology. In this way the work of the sociologists who have studied organizations was applied to classroom instruction. It was hypothesized that interdependent work relations among the children would reduce task uncertainty and thereby improve learning outcomes. The fact that different teachers used lateral relations among the children in varying degrees allowed us to test this hypothesis. As cited above, this hypothesis received strong support in the finding that talking and

working together was a predictor of learning on the content-referenced test.

A Sociological View of Implementation

Implementation was conceptualized as having three dimensions: differentiation of the technology; productivity of the student-workers, and occurrence of learning behaviors prescribed by the curriculum developer. It was hypothesized that the degree to which each of these three dimensions was implemented in the classrooms would predict learning outcomes.

Productivity and the prescribed learning behaviors proved to be direct predictors of learning outcomes. Degree of differentiation was only linked indirectly to learning outcomes. Differentiation appeared to interact with the other two dimensions such that optimal learning outcomes were produced when the instruction was more differentiated and a high level of individual productivity was present. Likewise, optimal learning outcomes were produced when more differentiation was accompanied by more student interaction (a prescribed learning behavior).

Implications and Conclusions

A General Approach to Instruction

This was not just an evaluation study of a particular curriculum. Using a sociological view, this curriculum may be seen as one example of a highly differentiated, rationalized type of instruction. Other highly differentiated curricula, such as many of the science curricula for the elementary schools, would be expected to have the same difficulties with implementation experienced by these nine teachers. They are likely to cut down on the level of differentiation recommended by the developer because they do not know how to delegate authority to lateral relations among the children. They also are not uniformly conscious of the necessity to control student output in ways other than routine supervision.

The results of this analysis suggest how these problems might be handled. Teachers can be provided with general principles concerning these management problems rather than demanding that they faithfully implement every part of the curriculum. Recognizing that they invariably make adaptations, they can be instructed not to sacrifice lateral relations or worksheet productivity with whatever changes they choose to make. Furthermore, specific assistance and modeling in how to delegate authority to children and how to maintain control over a decentralized system is in order. The teacher may come to understand that s/he can cut down on differentiation, but not at the expense of the other two dimensions.

<u>An Alternative to Individualization and Direct Instruction</u>

The success of this approach in an academically and linguistically heterogenous classrooms suggests an alternative to either individualization or direct instruction. This curriculum/approach features interacting students who take responsibility for completing their learning tasks, and seriously challenging learning materials with a high level of intrinsic interest. The teacher does not diagnose or prescribe, nor does s/he carry out direct instruction, recitation or drill. The teacher plays a critical managerial role at minimum.

This approach produces very high levels of engagement. Engagement produces active learning time and thus measurable gains in learning.

Basic skill improvement is achieved through practice in the context of intrinsically interesting tasks. Reading, writing, and computation have instrumental value in the completion of the learning tasks. It is possible to provide practice in basic skills in this way in curricula with a wide variety of teaching objectives. In this case the curriculum aimed at the development of thinking skills but produced gains in basic skills though active practice in a context that made sense from the point of view of the learner. These gains in the basic skills in no way compromise the achievement of the primary objective of the curriculum.

The success of this curriculum/approach, however, is based on some important conditions that would probably have to be met by any designer of instructional settings. The curriculum materials were challenging intellectual tasks and were extremely carefully prepared with instructions in two languages and pictographs. The tasks were open-ended ------ allowing children of varying developmental levels to carry out the activities in different ways. Basic concepts were taught through multiple activities with differing media and modes. The learning materials were items familiar regardless of class or cultural background. Furthermore, the teachers received the support of an aide and the careful preparation of all teaching materials.

In addition to these features of the curriculum and its preparation, there were important conditions of the classroom organization. Heterogenous small groups were used. The social structure made it legitimate for children to use each other as resources. Finally there was a strong set of demands, requiring each child to proceed to each learning center and finish each task and accompanying worksheet.

Although this method of organizing classrooms and instruction is "swimming against the educational stream" which is now returning to more direct methods of instruction, it is by no means impossible to achieve with ordinary classrooms and teacher-aide teams. There are undoubtedly curricular materials which could be adapted to the approach.

In closing, we hope it has become clear that sociological approach to classroom organization and instruction can yield new and different approaches to increasing educational productivity.

Footnotes

1. In this instrument, the coder could not distinguish whether talking was about the curriculum or not. Observer comments, however, indicate that most talk was task-related. Analysis of the data on individual target children tends to confirm this observation. In the Target Child Instrument, talking was broken into "on task," and "off-task." There was very little "off-task" talk in comparison to "on-task" talk.

REFERENCES

Ahmadjian, Janis. L. "Academic Status and Reading Achievement: Modifying the Effects of the Self-Fulfilling Prophecy." Unpublished doctoral dissertation, School of Education, Stanford University, 1980.

Berman, P. & McLaughlin, M. An Exploratory Study of School District Adaptation. Santa Monica, Calif., Rand Corp., 1979.

Berliner,David; Fischer,C; Filby,N; Marliave, R.; Cahen,L.; Dishaw,M.;Moore,J. Beginning Teacher Evaluation Study - Teacher Behaviors, Academic Learnng Time and Student Achievement: Final Report of Phase III-B. San Francisco, Calif.: Far West Lab., 1978.

Cohen, Elizabeth G.; Deal, T.; Meyer,J.; & Scott,W.R. "Technology and Teaming in the Elementary School." Sociology of Education, 1979, 52, 20-33.

De Avila, Edward. "Improving Cognition: A Multi-Cultural Approach." Final Report:NIE Grant No. NIE-G-78-0158. Stanford University,School of Education,February,1981.

De Avila, Edward & Cohen, E.G. "Multi-Cultural Improvement of Cognitive Ability." Final Report: State of Calif., Contract #9372. Stanford University, School of Education, August, 1981.

Fullan, Michael. "Research on the Implementation of Educational Change." In R. Corwin (Ed.) Research on Organizational Issues in Education. Greenwich, Conn.:JAI Press, 1980.

Hess, Robert & Takanishi-Knowles, R. Teacher Strategies and Student Engagement in Low-Income Area Schools Research and Development Memorandum no. 105. Stanford, Calif: Stanford Center for Research and Development in Teaching, February,1973.

McDonald, Fred J. & Elias, P.J. The Effects of Teaching Performance on Pupil Learning, Beginning Teacher Evaluation Study,Phase II, Vol 1, Princeton, N.J.: Educational Testing Service, 1976.

March, James & Simon, H.A. Organizatons. New York: John Wiley & Sons,1958.

Perrow, Charles,B. "A Framework for the Comparative Analysis of Organizations." American Sociological Review,1961, 32, 194-208.

Rosenholtz, Stephen. "Effect of Task Arrangements and Management Systems of Task Engagement of Low Achieving Students." Unpublished doctoral dissertation, School of Education, Stanford University, 1981.

Van de Ven,A. Delbecq,A.S. & Koenig,R. Jr. "Determinants of Coordination Modes Within Organizations. American Sociological Review, 1976, 41, 532-538.

Waldo,D. "A Theory of Organizations: Status and Problems." In Etzioni (Ed.) Readings on Modern Organizations. Englewood Cliffs, N.J.: Prentice Hall, 1969.

TABLE 1

Description of the Participants in the Experiment by Grade Level and Student Age

Grade Level	Number of Classes	N of Students who Consistently Participated	Average Age in Years
2/3	2	59	8.33
3	5	134	8.66
3/4	1	32	9.25
4	1	26	9.66

TABLE 2

Description of the Student Participants in the Experiment by Level of Language Proficiency

Level of Language Proficiency on Pre-Test	N
Minimal Language Proficiency in either English or Spanish	21
Limited Bilingual	69
Partially Bilingual	33
Monolingual in English	85
Monolingual in Spanish	22
Bilingual in Spanish and English	23
TOTAL Students Tested	253

TABLE 3

Reliability of Teacher Observation Instrument

Observer Number	Number of Times Reliability Was Assessed	Average % Agreement
2	3	.90
3	1	.91
4	1	.92
5	2	.88
6	3	.86
7	1	.93
8	1	.93
9	2	.89
10	3	.91
11	3	.91
12	3	.89
13	2	.91

Grand Mean = .90

TABLE 4

Reliability of Whole Class Observation Instrument

Observer Number	Number of Times Reliability Was Assessed	Average % Agreement
1	1	.90
2	1	.90
4	3	.90
5	2	.91
6	1	.85
7	3	.87
8	2	.98
9	2	.85
10	4	.94
11	2	.95
12	3	.90

Grand Mean = .91

TABLE 5

Reliability of Target Child Instrument

Observer Number	Number of Times Reliability Was Assessed	Average % Agreement
1	1	.93
2	2	.91
3	3	.89
4	3	.92
5	1	.89
6	2	.91
8	2	.98
10	1	.87
11	8	.93
12	1	.76

Grand Mean = .90

TABLE 6

Classroom Variation in Criterion Referenced Test and Standardized Achievement Test: Class Mean Scores on Pre and Post-Test

Student Outcomes: Mean Class Scores		Teacher Number 1	2	3	4	5	6	7	8	9
Science Mini-Test:	Pre	49.3	54.5	48.1	40.0	43.3	43.0	42.4	49.2	50.1
	Post	56.9	65.6	60.9	46.5	54.5	47.1	48.2	54.1	60.8
CTBS Math Test:	Pre	42.1	46.4	48.4	27.3	26.5	32.9	42.1	39.3	58.8
	Post	67.7	60.5	66.6	47.8	56.1	44.1	82.7	56.7	70.6
CTBS Math Applica-tion:	Pre	9.4	9.7	8.5	6.3	5.0	7.1	7.7	7.8	12.5
	Post	14.3	12.4	12.9	8.2	11.2	7.4	20.0	11.2	16.5

TABLE 7

Curriculum Weeks Completed by Each Classroom

Teacher Number	Curriculum Weeks
1	14
2	14
3	8
4	9
5	11
6	14
7	14
8	8
9	13

TABLE 9

Variation Among Teachers in Percent of Students Involved in Mediating Learning Activities, Differentiation of the Curriculum and Student Productivity

Implementation Variables	Teacher Number 1	2	3	4	5	6	7	8	9
Mediating Learning Process (Average Percent of Students Observed):									
Reading/Writing	11%	4%	12%	6%	6%	9%	13%	7%	9%
Talking(only)	9%	6%	9%	7%	16%	5%	7%	5%	18%
Talking while Manipulating Materials	17%	22%	19%	22%	26%	28%	28%	18%	34%
Manipulating Materials Without Talking	26%	11%	20%	20%	27%	31%	17%	21%	12%
Differentiation of the Curriculum (Average Number of Learning Centers in Use During Period)	4.1	3.8	4.8	6.3	4.7	5.1	6.6	2.3	6.9
Productivity of the Class (Average Number of Worksheets Completed by a Child in the Class over the Course of Activities)	104	65	62	46	69	42	67	34	73

TABLE 10

Average Frequency Per Three Minutes for Target Child Working Together with Peers: Means and S.D.'s for Nine Classrooms

Teacher Number	Av. Rate Per Three Minutes	S.D.	Number of Children
1	1.77	.89	7
2	1.84	.80	11
3	2.23	.59	13
4	1.65	.69	14
5	2.08	.52	12
6	1.95	.99	10
7	2.22	1.19	9
8	2.04	1.06	12
9	2.49	.84	12
Grand Mean =	2.04	.85	N =100

TABLE 11

Relationship of Observed Behaviors to Post-Test Scores:
Partialing Out Effect of Pre-Test Scores

Rates Of Observed Behavior	CTBS Math (n=65)	Content-Referenced Science Test (n=97)
Talk	.41***	.15
Manipulates	.21*	-.05
Manipulates + Talk	.20*	.17*
Works Together	.03	.21*
(Work Together)(Talk)	.09	.26**

* $p < .05$
** $p < .01$
*** $p < .001$

Table 12

ZERO ORDER CORRELATIONS AMONG IMPLEMENTATION AND OUTCOME MEASURES
(n = 9)

	Average # Worksheets Completed	Average # Learning Centers In Use	Average % Reading/ Writing	Average % Talking (No Manip.)	Average % Talking Total	Average % Manip.	Index Reading/ Writing & Worksheets	Index Talk & Worksheets	Index Total Imp.	Science Post Test	CTBS Math Total Post	CTBS Applic. Subscale Post
	1	2	3	4	5	6	7	8	9	10	11	12
Average Number Worksheets Completed	X	.07	.35	.43	.22	-.06	(.83)[a]***	(.85)***	(.72)**	.40	.57**	.54**
Average Number Learning Centers In Use		X	.35	.39	.65**	-.24	.25	.27	(.64)**	-.35	.29	.35
Average Percent Reading/ Writing			X	.00	.04	.15	(.81)***	.21	(.64)**	-.18	.63**	.58**
Average Percent Talking (No Manipulating)				X	(.88)***	-.21	.27	(.84)**	(.69)**	.32	.27	.31
Average Percent Talking Total					X	-.21	.16	(.43)	(.65)**	.10	.24	.34
Average Percent Manipulating						X	.05	-.13	-.10	-.56*	-.51*	-.52*
Index Reading/Writing and Worksheets							X	(.65)	(.83)***	.14	.73	.68**
Index Talk and Worksheets								X	(.84)***	.43	.50	.51
Index Total Implementation									X	.10	.67**	.67**
Science Post Test										X	.31	.26
CTBS Math Total Post											X	(.98)***
CTBS Application Subscale												X

TABLE 13

THE RELATION OF IMPLEMENTATION TO LEARNING OUTCOMES,
CONTROLLING FOR MEAN LEVEL OF KNOWLEDGE OF MATH/SCIENCE BEFORE IMPLEMENTATION
(n = 9 classes)

Implementation Variables (Standardized Scores)	Partial Correlation with Learning Outcomes (DF=6)		
	Math Total Subscale Score on CTBS	Application Subscale in Math CTBS	Score on Content Referenced Science Test
I. Individual Relations of Dimensions of Implementation to Outcomes			
Productivity: Average number of worksheets completed by students in a class.	.49	.44	.31
Differentiation of Curriculum Process: Average number of learning centers used in a class.	.27	.32	.32
Mediating Learning Process:			
Percent of class observed Reading/Writing during FO/D period.	.57	.57	-.02
Percent of class observed Talking or Discussing with others.	.13	.21	.64**
Percent of class observed Talking and Manipulating materials during FO/D period.	.09	.23	.45
Percent of class observed only Manipulating materials during FO/D period.	-.13	-.31	-.23
II. Indexed Measures of Implementation (Likert type scales) using Two Dimensions of Concept			
Mediating Learning Process and Productivity:			
Percent Reading added to average number of worksheets completed in a class.	.66**	.62*	.17
Percent Talking added to average number of worksheets completed in a class.	.39	.37	.56
Productivity and Differentiation: Average number of worksheets completed in a class added to average number of learning centers in use.	.54	.54	.39
III. Indexed Measures of Implementation (Likert type scales) using Three Dimensions of Concept			
Mediating Learning Process, Productivity and Differentiation			
Percent Reading added to average number of worksheets produced and average number of learning centers in use.	.66**	.65**	.25
Percent Talking added to average number of worksheets produced and average number of learning centers in use.	.41	.45	.56
Total Implementation:			
Percent Talking added to percent Reading, average number of worksheets produced, and average number of learning centers in use.	.57	.60*	.44

*n≤.10. **n≤.05.

TABLE 14

Frequency Distribution of Rates of Off Task Engagement

% Time Off-Task	n	% of children in Target Sample
0%	19	19%
1% - 10%	48	48%
10.4% - 13.6%	12	12%
15% - 18.8%	10	10%
24.1% - 27.1%	5	5%
33.9% - 44.6%	6	6%
Total	100	100%

TABLE 15

Zero Order Intercorrelations of Implementation and Learning Measures:
Individual Target Children

	Math B	Read B	Mini B	Math A	Read A	Mini A	L.C.' in Use	Read/ Write	Work/ Talk	Off Task
Math B	1.00	.614***	.462***	.634***	.504***	.403***	.201	.258	.337**	-.379**
Read B		1.00	.584***	.532***	.844***	.581***	.079	.325**	.094**	-.326**
Mini B			1.00	.442***	.627***	.637***	-.009	.202	.267*	-.198
Math A				1.00	.561***	.481***	.133	-.037	.427***	-.182
Read A					1.00	.682***	-.071	.152	.082	-.241*
Mini A						1.00	-.128	.031	.128	-.062
L.C.'s in Use							1.00	.141	.231*	-.223*
Read/Write								1.00	.016	-.137
Work/Talk									1.00	-.353**
Off Task										1.00

Variables: Test A refers to Pre-test scores; Test B refers to Post-Test scores; L.C.'s in Use = Average No. Learning Centers in use; Read/Write = Average Frequency of Reading/Writing observed for Target Child; Work/Talk = Product of Average rate of Target Child Talking About Tasks multiplied by Average Rate of Target Child Working Together with Others; Off-Task = Average Rate of Off-Task Behavior for Target Child.

N = 63

* p<.05
** p<.01
*** p<.001

TABLE 16

Regression on Three Learning Measures of Observed Rate of Disengagement for Target Children: Holding Constant Pre-Test Scores and Classroom Level of Differentiation

Dependent Variable	Predictor	Beta	F	R^2
Math CTBS Post-Test	Math CTBS Pre-Test	.578	39.30***	.402
	No. Learning Centers in Use	.066	.508	.416
	Rate Off-Task	-.259	7.61**	.478
Read CTBS Post-Test	Read CTBS Pre-Test	.828	156.37***	.712
	No. Learning Centers in Use	.115	3.06*	.731
	Rate Off-Task	-.101	2.24*	.741
Science Mini Post-Test	Science Mini Pre-Test	.633	44.02***	.406
	No. Learning Centers in Use	.039	.16	.411
	Rate Off-Task	-.151	2.41*	.433

N = 64

* p<.05
** p<.01
*** p<.001

TABLE 17

Regression on Three Learning Measures of Observed Rate of Reading/Writing and Talking/Working Together: Holding Constant Pre-Test Scores and Classroom Level of Differentiation of Target Children

Dependent Variable	Predictor	Beta	F	R^2
Math CTBS Post-Test	Math CTBS Pre-Test	.611	37.57***	.402
	No. Learning Centers in Use	.069	.54	.416
	Read/Write	.270	9.94**	.487
	Talk/Work Together	.060	.300	.490
Read CTBS Post-Test	Read CTBS Pre-Test	.824	173.40***	.712
	No. Learning Centers in Use	.112	3.02*	.731
	Read/Write	.188	8.59**	.764
	Talk/Work Together	-.001	.000	.764
Science Mini Post Test	Science Mini Pre-Test	.603	39.47***	.406
	No. Learning Centers in Use	.009	.00	.411
	Read/Write	.179	3.76**	.441
	Talk/Work Together	.186	3.81**	.473

N = 63

* p<.05
** p<.01
*** p<.001

APPENDIX A

Guidelines for Scoring

Teacher may be watching disengaged students or students in transition.

Academic Task:

Teacher may be g rading papers, correcting work sheets or working with work summaries. This category includes non-interactive ,academic teacher role behavior.

Taking Notes:

This category refers specifically to taking notes on children who are engaged in the MICA curriculum.

Interaction with other adults

Signals :

This is a non-verbal communication between the teacher and another adult. For example, may be signalling to go ahead with activity,that it is time to close down the activities, or that she wants to see the aide.

Academic Management discussion:

Teacher talks with other adult about individual problems, problems with activities, problems with timing. Either facilitating activities or instruction on content may be subject of discussion.

Joint Teaching:

Teacher an another adult are working jointly with the very same group of children. Does not include case where aide is in charge of a Learning Center and teacher comes by, stopping to make a comment to the group or to an individual in the group. They must have obviously decided to work together.

Sequential Reports

Teacher instructs the aide rather than discusses with the aide. Aide reports to teacher and teacher makes a decision what to do without discussion.

Example: Aide comes up to report that children are almost finished with the activity. Teacher tells her to get them started on other work.

Interaction with group

Introduces Learning Center

This may be addressed to whole class or small group. It is essentially teacher talk. If one child asks a question and teacher addresses explanation to that particular child,then score below under Act to Individual:Instructs--Explains.

Discusses Multiple Abilities

This refers specifically to instructions given in the workshop to teacher. She was supposed to point out the various skills involved in each Learning Center and to ask the children what skills they thought were involved. She was supposed to tell them t at no one child would be good at all the abilities involved in a L.C.,but each one would be good at some.

If teacher becomes involved in a discussion with an individual student, score below.

Example: Teacher is discussing multiple abilites involved in a measurement task. She asks the children to mention some of the abilities they think are involved. One child speaks up and names a skill. Teacher says, "OK ,that's good." Another child names another ability. Teacher says," That's a good suggestion that I never would have thought of. I like the way you are using your imagination."

Scoring Example.

Check off teacher lecture under "Discusses Multiple Abilities. When teacher speaks to first child, score act in bottom half of sheet as Act to Individual. Make a notation under Evaluation, General Positive. The response to the second child is a second Act to Individual. Note under Feedback, Skills because the teacher is making her evaluation very specific and is commenting on one of child's skills.

Behavior Management

Teacher may comment to class or sub-group about too much noise, not settling down at their Learning Centers, too much fooling around, not finishing up their activities in good time. She may make a general warning, "Some people need to get back to work." In general behavior management refers to reinforcing, stating, or sanctioning the basic rules for behavior in the classroom, particularly those roles necessary for MICA operation.

Instruction:Content

Teacher talks to a group about content of MICA math and science. May include defining new vocabulary. May include asking academic questions of the group.

Facilitates Activities :

Teacher helps students to understand what they have to do to complete activities or worksheets. It does not include academic content. Remark is addressed to a group. May talk about some difficulties students are having with the activity, such as getting a paper model to stay glued together and how to solve those problems.

Feedback on Progress :

Teacher comments to a group, usually at a Learning Center on how they are coming along on their task. May include a remark on their general progress, how well they are working together or may be specific to the group's production on the current activit or worksheet.

Be careful here. If remark is distinctly addressed to an individual in the group, score in the Acts to Individuals section.

Acts to Individuals

This section of the scoring sheet is exclusive concerned with acts of teacher addressed to individuals. Each numbered column refers to an uninterrupted conversation or speech with a single individual. It may contain several different topics which will all be noted. It may involve any number of specific interactions between the teacher and that individual uttered in a sequence. If it is interrupted by a remark to another individual, then this particular conversation is at an end! Move on to the next column to score the teacher's remark to another individual. If the teacher refers back once more to the first individual and addresses another remark to that persoh, then move on to the following column. Because it has been interrupted by interaction with another individual, it must be scored as a new "talk" to individual. Also, if the teacher interrupts her talk to an individual to talk to a group, check off on the top half of scoring sheet and proceed to a new "talk" column whether or not the teacher ~~XXXIXXX~~ resumes talking to the same individual.

Notation system. When scoring teacher talk one must consider several things at once: what categories does this talk contain,i.e. which row should be scored? A given talk may well(and usually does) contain more than one category of content. The second thing to be noted is whether or not this student has been talked to on an individual basis by the teacher previously in the scoring period. As a new student is contacted or contacts the teacher, make a check mark on bottom of scoring sheet,so you may tote up the total number of different students talked to. It does not matter whether the teacher or the student initiated the contact. The third thing that has to be kept in mind is the language the teacher is using. This is recorded very simply:

When you go to score a cell on the scoring sheet, fill in an S for a remark in Spanish, an E for a remark in English and put in both if two languages are used. You do not need to make any mark aside from these letters in the boxes. If there are a number of rows involved in a single conversation, mark each one with the appropriate letter for the language involved.

If you score more than 16 units of conversation or talk, go on to the next scoring sheet. Use the top half of the next scoring sheet for teacher scores not addressed to individuals rather than go back and forth between scoring sheets.

Management:Discipline

This has the same definition as Behavior Management in the top scoring section. It refers to reinforcing,stating or sanctioning the basic rules for behvaior in the classroom,particularly those behaviors necessary for MICA operation. It does not refer to helping the child with activity. It does include the teacher telling an individual to "get back to work."

Facilitates: Activity,Worksheet

Same definition as Facilitates in top half of sheet. Must refer, in this category specifically to MICA activity,worksheet(or work summary. Be careful to distinguish it from some substantive remark such as, "Yes, that is a triangle." Score that remark under Instructs:Language and Vocabulary.

Facilitates: Finish Previous Worksheet

This category is designed to catch the teacher's reference to work from a previous Learning Center i.e. the worksheet a child either failed to finish or did not attempt at all. In the teacher's remark must be clear evidence that she has looked for or has studied the student's previous worksheet. It will typically be combined with feedback on the correctness of responses on the worksheet, or with some evaluative remark, with feedback on child's progress or with redirecting student back to a Learning Center.

Facilitates: Student to Learning Center

Teacher either directs a child to a Learning Center to start or finish up an activity; or teacher tries to facilitate child's choice of which Learning Center he/she should do next. Teacher may be going over work summary with child and pointing out that he/or she still must do several particular Learning Centers.

Instructs: Explain,Inform(Substantive)

This category refers to math science content of the MICA curriculum. It is important to distinguish substantive teaching from mere facilitation of activities where child is to gain the substantive understanding from the activities and worksheets themselves.

Instructs: Questions(Substantive):

Teacher ask students questions in math and science. They may be the questions we provided or the teacher may be asking her own. The teacher is trying to get the student to think about the problem at hand.

Instructs: Extend Activity

The teacher is directing the student to extend his activity.Perhaps the student is doing the activity at too low a level of cognitive development. Perhaps the teacher things it would be intereeting and informative for student to develop what he/she is doing.

Talk About: Student Interests

The teacher may ask the student whether some particular activity or aspect of an activity interests him. The teacher may comment that :"You see very interested in measuring the Monster."

Talk About: Student Skills

Skills are broadly defined as the full range of abilities relevant to the task. The teacher may ask the student about skills so as to open the conversation. Be careful to distinguish this "Talk About" category from Feedback on Skills. If the teacher goes on to document what skills the student needs to develop or what skills he does particularly well on,in a specific fashion,then it

should also be scored as Feedback:Skills.

Talk About: Student Feelings.
Teacher may be discussing student's behavior with respect to others, such as a quarrel the child may have had during the course of an activity. Or the student may have shown strong feelings of frustration or triumph with respect to an activity.The teacher is discussing these feelings.

Feedback: Previous Worksheet
Teacher is talking specifically about what a child did in the way of responding to the previous Learning Center's worksheet. She may be pointing out where a mistake was made. She may be commenting on why she liked the way he answered a particular question. The comment must be specific enough to give the child information on exactly what he did right or wrong and why the teacher evaluates it the way she does. If it is only a remark about filling in the missing items,then score as Facilitates:Previous Worksheet. If remark is evaluative but diffuse or general, score under evaluation .

Feedback: Current Acitivy or Worksheet:
Teacher specifically lets child know something about his performance on the current activity or worksheet. This feedback must be specific enough to act as a guide to some conceivable furture performance. For example,"I like the way you taped that part of the model."; this would be scored in this category.

Feedback: Skills:
Teacher specifically lets child know something about his skills or abilities. She may tell him he does very well on some specific skills. She may tell him that he is having problems with multiplication and proceeds to explain just what he did wrong. If she launches into a little lesson about multiplication, it should also be scored under Instruct:Explain. These are not just conventional subject matter skills,but may refer to skill in observing,manipulating reasoning,experimenting etc.

Feedback: General Progress:
Teacher may go over with the child what he has been able to accomplish at various Learning Centers. She may or may not use Work Summary for this purpose. She may be referring to general progress in learning to read and follow instructions or manage the worksheets.

Feedback: Working Together:
Teacher specifically comments on how child works together with others. It may involve asking for assistance,offering assistance or working as part of a group. Feedback may be negative or positive.

Evaluation: General Positive

This is non-specific positive reinforcements. Such remarks as "Good work,Juan," or"OK, that's good.";"Very nice." "You're doing fine." should be scored here if they are not accompanied by anything specific. If they are, then score the whole remark under Feedback.

Evaluation: General Negative

This is like the above in that it is general and diffuse. If the teacher is scolding the child for inappropriate behavior, then score it under Exxx Management:Discipline. REmarks such as, "I know you can do better;" "That's rather sloppy work." "You have many things wrong on your worksheet." all would be scored here.

Identifying peculiar MICA events

a. Teacher directs kids about clean up.

Score: Facilitates:activities

b. Teacher says to student:Will you go over there and show her how to do it?

Score: Facilities:Student to Learning Center

c. Teacher asks student to show her how he derived answer on worksheet She listens to his explanation and say, "Good,you are right."

Score: Feedback:Current Worksheet

This is scored as feedback and not "general positive evaluation" because student knows specificially which intellectual operation was good and correct. He can "use this information in future performances calling for similar arithmetic operations.

MICA PROJECT

Teacher Observation

Cover Sheet

Teacher_____ Observer_____ Observer No._____

Date_____ Time at start of Observation_____

Number of adults working with children in addition to teacher. _____

Week of Activities with which teacher is engaged._____

Describe below what aides and volunteers are doing relative to the teacher.

Code activities of Aide(s) and Label aides and volunteers A_1, A_2, etc. Code activities in categories below at start and finish of timed observation of teacher. Check as many categories as appropriate.

_____ Non-MICA Activity

_____ Clean-up or Set-up

_____ Working on Worksheets or Work Summaries

_____ Roving, Monitoring

_____ Stationary, Supervising Group of Students

_____ Taking Observation Notes

_____ Talking with Other Adults

_____ Talking, Instructing, Facilitating Group of Students

_____ Interacting with Individual Student

Explain what teacher is doing during the course of your observation. If some incident occurs which commands teacher's attention, describe.

Comment on noise level, traffic pattern problems, obvious difficulties with materials at particular Learning Center. Note which Learning Center is producing a particular problem, if any.

TEACHER OBSERVATION			TCH. NOT INTERACTING
Cleaning	Roving/Monitoring	Academic Task	Taking Notes

Signals	Acad/Mgmt Discussion	Joint Teaching	TCHR W/OTHER ADULTS Seq. Reports

Intro. Lrng. Ctr.	Discusses Multi. Abils.	Behavior Management	Instruction Content?	TCHR W/GROUP

Feedback on Progress	Facilitates Activities

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TCHR W/INDIV STU
																DISCIPLINE
																FACILITATES Activ.; Wksheet
																Finish Prev. Wks
																Stu to Learn Ctr
																INSTRUCTS Explain, Inform(S
																Questions(Subst.
																Lang & Vocab.
																Extend Activity
																TALK ABOUT Stu. Interests & Feelings
																Stu. Skills
																FEEDBACK Previous Wksheet
																Current Activity or Worksheet
																Skills
																Gen. Progress
																Working Together
																EVALUATION Gen. Postive
																Gen. Negative

CTS:
nin-
err
pted
alk
/a
hild
****
=Sp
=Eng

No. of Diff. Students for Above Acts: _____

Total No. of Times Spanish Used: _____

Total No.: _____

Date: _____

Teacher: _____

Observer: _____ Ob.# ___

MICA PROJECT
Whole Class Observation

Guidelines for Scoring

Whole class observations will be scored twice during a visit. You will be instructed as to the order in which this instrument will be filled out relative to the other instruments.

This measure is intended as a quick cross-section of what is going on in the classroom. You must systematically view the class so as to locate each student and the adults in the class. If you study any one group of children too long they are likely to change grouping pattern or activity; and this will make it difficult for you to classify them. Put down what they were doing when you first saw them and move on.

Before you start: Fill out the top of the scoring sheet. Count how many children there are in the class and fill in the blank. Your scoring on the grid should add up to the total at the top of the sheet. If someone leaves the classroom while you are scoring, note at bottom of scoring sheet. Also, be sure and fill in the names of the Learning Centers in Operation at the bottom of the scoring sheet opposite letters A, B, C, etc. In your scoring, you will be using the letters to stand for the Learning Centers.

Definitions: Detailed instructions for scoring are found at the bottom of the scoring sheet. There are several definitional problems which we will clarify here.

What is a group? The scoring scheme requires you to distinguish between individuals working on separate tasks with others (denoted by ( ) and an *) and a group (deonted by ( )). A group is defined as more than one person engaged in a collective task. This may be momentary as when two children confer over the right answer on the work sheet or when one helps the other in understanding an activity. Or it may be

Whole Class Observation

Guidelines for Scoring

a project on which two children have been assigned to work as a pair. The key thing to watch for is interdependence relative to the task. It will include comparing notes as they manipulate activities, two children manipulating the identical materials with more children watching and commenting, doing the worksheets together.

There are some cases that will be hard to distinguish. Following are some examples: (1) All the children at a Learning Center are working on parallel tasks, looking at their own work. There is occasional talk as you glance at them. Unless you are sure that they are actively discussing a task related issue, be conservative and score as individuals working on separate tasks with others. (2) Children are alternately filling out worksheets and discussing answers. How you score this depends on what they are doing when you first see them. Even though one of them is, for the moment, engaged in writing and will probably join in the discussion in the next moment, put that student down as engaged in individual task of writing.

Definition of "in transition on business". We want to distinguish, on the one hand, the S who is completely off task from the S who is away from a Learning Center activity-engagement but who is doing something related to school work such as bringing up worksheets, sharpening pencils, getting Scotch tape. On the other hand we want to distinguish this kind of behavior from that which is more directly related to learning such as manipulating the materials. This category should include the child who is watching others at a Learning Center, probably while trying to decide what Center to do next. It should also include a child who is talking to the teacher, but not at a Learning Center.

ATE: _____

ay: M___ T___ W___ Th___ F___

ime of Day _____

o. Students in Class _____

MICA PROJECT
Whole Class Observation

ACTIVITY

School _____

Teacher _____

Observer _____

	Engaged at a Learning Center						Not Engaged at a Learning Center			
GROUPING	Reading Writing	Manip-ulative Material Only	Talking Discuss. Task	Thinking Observing Listening	Mixed Manip. Talking	Other Academic	Clean up	Waiting for Adult	In Transi-tion (on * business)	Wandering Playing Daydreamin
Individual - Working on individual, separate task alone or w/others.										
students working on same task)										
mall group (3-6) working on same task).										
ther larger roup (7+) orking on ame task).										

Instructions: 1) Use numbers to indicate no. of children in a given category. Use letter to indicate which Learning Center they are at. Use ( ) to indicate a group: Example: (4A) = four children working together in a group at Learning Center A.

2) If an adult is with an individual or a group indicate with the following appropriate subscripts:

T = teacher A = aide

Example: (2B)T = teacher working with a pair of children at Learning Center B.

3) If the students working on the same task are not together physically as a group, but just working side by side at a Learning Center or elsewhere, indicate this by using an asterisk (i.e. (6C)*).

Fill in for one of the two observations at a given visit which Learning Centers are in operation.

A: _____ E: _____ I: _____

B: _____ F: _____ J: _____

C: _____ G: _____ K: _____

D: _____ H: _____ L: _____

* In Transition (on business) includes S's standing and looking at a Learning Center; also children in transit talking to teacher.

11.9/79

MICA PROJECT
Target Child Observation

Guidelines

This observation has two purposes(1) to examine the implementation of the curriculum on an in-depth individual basis and (2) to examine the language usage of children from three different language groups: English dominant; Spanish dominant; and t ose who have a weak grasp of both languages.

The observer will study one child at a time in a classroom for 3 minutes of timed scoring. Each target child will have a subject number. The order of observation during a vist will be pre-determined by a random number table. There will be a separate observation schedule sheet for each student for each 3 minute observation. Each 3 minute observation is further subdivided into minute and 30 second intervals.

At the start of each observation, before the timing begins, the observer locates the target child and fills out the cover sheet which contains all the identifying data, a description of what the child is doing, and coding categores for the activity of the target child. After the observation is over you will want to r eturn to the cover sheet to fill in more detail on what the child has attempted to do vs a vs MICA activity.

TIMING PROCEDURES: It is necesamry to have your watch with a second hand, or a stop watch in a place where you can clearly see the seconds progress. You cannot do this properly if you are standing with a clipboard and have your watch on your wrist. It makes it much easier to keep track of the seconds if you start your observations on the minute. If, for some reason , you have to pause between 30"" intervals, then waid till 30" has passed and start with the next 30" interval.

UNIT OF SPEECH OR BEHAVIOR: The timed observation method requires checking specific observed behaviors which occur in the time intervals on the code sheet. In coding behavior, as long as that behavior is uninterrupted by another type of behavior listed on the code sheet, then make only one notation per 30" interval. If that behavior continues into the next 30" interval, note it once more in the next time interval.

In coding speech, notate only once until that talk is (1) ended by the response of another person; or(2) changes into another scorable category of talk. If the speech is long and persists into the next time interval,it should be scored once more. If the Target Child(T.C.) is engaged in a conversation about the MICA activity with another child(S),you may score several speeches even in such a short interval as 30".Children's speeches are typically short and everytime the other student speaks,the unit of speech has ended. When the T.C. speaks for a second time,it counts as another score.

Sometimes you will score in a speech and behavior cell simultaneously. For example if the T.C. is working together with another child and talking to that other child about the task, note both in the cells "working together" and "Task-related talk."

Guidelines

NOTATION SYSTEM: The notation system for verbal acts is different than that for behavior. Please be careful to note the differences.

Verbal Behavior: You will note that the scoring sheet is divided into three sections: Target Child Talk; Adult Talk; and Target Child Behavior. You will use the following notation system in all "Talk" categories:

To whom is the actor speaking? Note this with the following codes.

T.C. = Target Child
T = Teacher
A = Aide or volunteer
S = another student
S = a pair or more of other students(group)

Follow this information with a slash(/)

In what language is the actor speaking? Note this with the following codes.

Sp = Spanish
E = English
Sp + E = Both languages

Examples: Suppose a teacher comes up to the target child you are watching and starts talking to him ,helping him with the activity he is doing."Herexxxxxxxx Amelia, you are supposed to cut it this way and then do the folding." Amelio: I can't get it to stay down when I fold it." Teacher: "Maybe you should go get some Sotch Tape." This interchange all takes place within a 30" time interval.

Score The first teacher speech = T.C./E entered in the cell marked Teacher:Facilitates. The student speech is = T/E and is entered in the cell marked T.C. TALK:Task Related.
The second remark of the teacher is scored as T/E and is entered in the same Teacher:Facilitates cell as the first teacher speech.
MAKE SURE YOU UNDERSTAND WHY THIS EXAMPLE IS SCORED IN THIS WAY.

Non-Verbal Behavior: For this lower part of the scoring sheet you need only make a check mark in the correct cells. If the behavior is interrupted but recurrs within 30"" it is possible to make two checks in a given cell.

Example:T.C. is watching a peer at work. He/she pauses to take a playful poke at another child who passes by. He/she then turns back to continue watching. If this all occurred within 30",there would be 2 checks in the Watches Others Cell and one check in Clearly Off Task.

Guidelines

Detailed description of ADULT TALK categories

These categories refer to adult verbal acts directed toward the target child. If the target child is part of a group, to whom the adult is talking, simply indicate this by putting G/ . Please note,the adult does not have to have initiated the conversation in order for the act to be scored in these cells. The child might have come over to the adult and asked a question or raised a hand. If the child asked a question, this should be scored once in the T.C. Task-Related Talk Category with the adult listed as the actor to whom the remark was addressed. Secondly it will be scored in the ADULT TALK categories when the adult answers the child.

The three types of Teacher or Aide Talk are basically the same distinctions made in the Teacher Observation Instrument. The adult is doing the following

Teacher or Aide Facilitates : The adult is helping the student to understand what they have to do to complete activities or worksheets. It does not include academic content. May include directing a student to a Learning Center. May indicate to child how many more items have to be filled out on worksheet. May read the instruction out loud to the child.

Teacher or Aide Instructs: Teacher or aide talks about content of MICA. May be trying to extend activity. May be helping or reinforcing new vocabulary or assisting with writing or spelling on the worksheet. May consist of asking the child questions which have the function of testing his understanding or persuading him to think about the problem. Do not score as instruct unless this is clearly what the teacher is doing.If teacher is talking about activity,and you might infer,she has instructional goal in mind, do not code as instruction unless there is definite evidence that this is the case. Otherwise score as facilitate. Instruction in this instrument includes Feedback and Evaluation.

Teacher or Aide:Discipline . This only refers to attempts to control the child's behavior.These attempts do not facilitate activity.Please see special note on this distinction in the addendum to Teacher Observation instrument.

TARGET CHILD TALK CATEGORIES

Task-Related Talk

Target Child is talking about his/her work broadly defined. Any remark relevant to the materials,work sheets should be scored. Even if the child is talking about other experiences he/she has had with popcorn,raisins,cameras--it should be scored. If child is discussing the behavior of other people at the Learning Center or which Learning Center is better, count this as task-related. If the child

is responding to an adult's question, the response should be scored here.

Requests Assistance

Any verbal request for help on reading, with activity, or with worksheet should be scored here.

Offers Assistance

Any verbal indication that child is willing to assist a peer on the MICA task should be scored here. If teacher has directed T.C. to go help someone and he/she goes over to offer assistance (verbally), score here.

Non-Task Related Talk

Children may talk about their families, how other children behaved at recess, whether or not they like other children, or what they are going to do after school today. It should be clearly unrelated to MICA to fall into this category.

TARGET CHILD BEHAVIOR CATEGORIES

Clean-up. Child is cleaning up activities at the Learning Center or filing papers away.

Works on MICA (alone)

The operational definition of alone and together is much stricter for this instrument than it was for the Whole Class Observation. First, any conversation between the children is scored above under TALK categories. Secondly, we will use a much stricter definition of "working together" so that if a child is clearly at work in MICA, but not fitting the "working together" criteria, then score as working alone. This will include such cases as all the children at a Learning Center manipulating their own materials and talking about the task. It will also include the case where children are filling out worksheets and occasionally announcing what they are putting down in the way of an answer.

Works Together with Others

When the children are working with a single set of materials as in a group project, score in this category. You may also score in this category if one student moves over or leans over to manipulate another's materials and they are clearly working in a joint fashion for at least this portion of the task. You may also score if one student is looking on as n another works and is discussing with him what should be done or why it is or isn't being done right. On the worksheets, if one child is clearly in conference with T.C. (or perhaps more than one) over what is the right answer. This is distinguished from merely talking about the worksheet. Some kind of interdependence for obtaining the answers should be clearly observable to be called "working together."

Watches Others on Task, Thinking

Of course you can't tell for sure whether someone is thinking by observation. However, the rule is that you should not mark OFF TASK unless you have clear grounds for doing so. Thus, if you are not sure whether child id daydreaming or thinking, you will always mark it here.

Waits for Adult

Child may follow adult around the room to obtain attention. Or aide may be working at the Learning Center with each child, in turn. Your T.C. may be waiting for his/her turn.

In Transition (on Business)

Child may go to get materials. He/she may be in the process of choosing the next Learning Center. He/she may take the worksheets and walk across the classroom for help. This should be double scored as IN TRANSITION and WAITS FOR ADULT (if there is some waiting).

Rule: If children are arguing about materials, DO NOT SCORE under verbal categories, but put down here under IN TRANSITION.

Clearly off Task (MICA)

In order to score this category you must be quite sure that the child is disengaged. Cues include looking at unrelated pictures on the wall, interfering, teasing or playing with others, wandering around the room aimlessly, clearly playing with objects (like a pencil as opposed to playful manipulation of MICA activities).

Other Academic Work

We are only interested in engagement and implementation of MICA. Therefore, regardless of how engrossed a child is in unrelated academic work or how frequently he/she talks to others about that work, we are not interested. Therefore, regardless of what is being said or the level of engagement, if T.C. is supposed to be doing other academic work, continue to score in this category until he/she starts doing MICA related activities.

MICA PROJECT

Target Child Observation

Cover Sheet

Teacher: _____

Student: _____

Observer: _____

Date: _____

Activity Coding:

Working at Learning Center Yes _____ No _____

* If YES, code activity at Learning Center

_____ Reading or Writing

_____ Manipulating Material

_____ Talking or Discussing Task

_____ Manipulating Materials & Talking or Discussing

_____ Thinking, Observing, Listening

* If NOT actively working at Learning Center, code activity

_____ Other Academic Work

_____ Waiting for Adult

_____ In Transition (on business)

_____ Clean-up

_____ Wandering, Playing

Grouping Code: Only code here if student is working at Learning Center

_____ Working Alone

_____ Working with Another Student

_____ Working in a Small Group (3-6)

_____ Working in a Large Group (7+)

Briefly describe what child is doing. If at Learning Center, which Learning is it?

What particular MICA activity is she/he working on? What is he/she attempting to do?

_____

_____

_____

_____

_____

_____

_____

* Put in A or T beside check mark if Aide or Teacher is clearly supervising the activity. It should be so obvious that child would know he was being watched.

Page 2. Target Child Observation — SCORING SHEET

Teacher_____

Student_____

Observer_____

Date_____

Target of Talk: T = Teacher; A = Aide;
S = Other Student(s); TC = Target Chil
G = Group of Students

Language Used: Sp = Spanish; E = English
Sp + E = Mixture of languages

Coding Category	Minute #1		Minute #2		Minute #3	
	1 - 30	31 - 60	1 - 30	31 - 60	1 - 30	31 - 60
T.C. TALK Task Related						
Requests Assistance						
Offers or Gives Assistance						
Non-Task Related						
ADULT TALK TO T.C. Teacher: Facilitates						
Teacher: Instruction						
Teacher: Discipline						
Aide: Facilitates						
Aide: Instruction						
Aide: Discipline						
T.C. BEHAVIOR Clean-up						
Works on MICA (alone)						
Works Together with Others						
Watches Others on Task, Thinking						
Waits for Adults						
In Transition (on business)						
CLEARLY OFF TASK (MICA)						
Other Academic Work						

Teacher_____

Student_____

Observer_____

Date_____

Describe briefly what child has completed at end of observation if working at Learning Center. If child changes activities and location during observation period, describe.

_____

_____

_____

_____

_____

_____

_____

_____

_____

If the following was true of the time of your observation, please check as appropriate. Check only if you are quite sure that you can infer this from observed behavior.

_____ Child having trouble reading directions or worksheets.

_____ Obtained assistance or figured it out.

_____ Did not obtain assistance.

APPENDIX B

Classroom Descriptions

Overall: Had a teacher switch during the course of the activities, approximately after the teacher had reached week 6 or 7 with the activities. The aide remained the same. The original teacher and the aide had participated in the pre-year MICA training. The new teacher had not had that training. The new teacher had an individual session with the project coordinator; and was able to discuss problems with MICA in her team meetings. She was in the intensive condition. The first teacher felt a lot of pressure from the principal to accomplish her 'objectives' and MICA was seen as a competing element--although it worked in a complimentary way, MICA was seen to take away from time directly spent on the task of the objectives. Notwithstanding the first teacher was very enthusiastic about MICA, as was the second teacher and the aide. The aide was sick alot initially. The second teacher followed the routines set up by the first, because we requested it.

SES data: (Prin) 85% of the students in this class were on free or reduced lunch.

Classroom Info: (TQ pre MICA) There were no special criteria upon which children were assigned to this class. Classroom was self-contained.

From the records (as of 4/10) for the target kids, absenteeism ranged from 0-24 days absent: 2 children were out 8 or 9 days; 1 child was absent 16 days; and 2 children were absent 21 to 24 days.

Teacher Info: (TQ pre MICA) The first teacher had 3 to 5 years teaching experience. She had used learning centers in non-core areas before (e.g. health & art). The second teacher had just started teaching; this was her first assignment. Both teachers and the aide spoke Spanish. The first teacher rotated tasks with the aide; with the aide's principal responsibility thought of as clerical--collecting monies from the students, recording grades. The aide occasionally gave original instruction to the large group or individual students, supervised student work, acted to give the teacher information about specific student behaviors.

The aide was present for 71/2 hours day. She was not a credentialed teacher.

MICA in this class: (observers recorded comments) Set-up & Management: Teacher and aide set up the activities before the period began; and cleaned up after it ended.

Facilitation: Teacher roved and monitored; occasionally she worked intensively with an individual group of students on a difficult concept; sometimes giving original instruction. The aide worked with individuals on worksheet problems. Most often she stayed where the more difficult activities were located.

Emphasis on the worksheets: There was heavy emphasis on the worksheets. The teacher checked every worksheet for spelling errors; and students had to hand them in to the teacher or aide before could proceed to the next activity.

Degree of understanding or trouble with the activities: Teacher may not have had a flare for science, but she went through each of the activity panels herself and tried to do the activities by herself at home from the panels before the kids used them; eventually the teacher and the aide divided up this task of getting to know the activities so that it became less burdensome and so that the aide understood more of the objectives for each task. At first neither the teacher nor the aide had a high degree of understanding and therefore had some trouble with the activities. Soon the teacher developed this practice of going through the activities, however, and things changed dramatically.

Use of Spanish: Spanish was used by the aide and by the teacher regularly to individuals and the group as a whole.

School Profiles (School B) 7/3 Grade

Overall: This school had 1 teacher and two aides consistently present during the experiment. All three participated in the MICA training sessions. The class completed the curriculum; and the teacher was extremely diligent about handing in all the materials we could possible desire--notes on students, notes on their own implementation of the curriculum, etc.

SES data: 45% of the class were awarded free or reduced lunch (Prin letter)

Classroom Info: There was no particular basis upon which students were assigned to this class. This was a self-contained classroom. The teacher was very concerned with giving the child a quality experience led by the teacher. From the records, for the target children in this class, absenteeism ranged from 3 to 13 days (as of April 1, 1980 4 children were out 3-4 days; 1 child was out 5 days; 1 child was out 7-10 days; and 1 child was out 13 days.

Teacher Info: (TQ pre MICA) Teacher has over 20 years of experience in teaching She speaks Spanish; has a Cuban background. She has used learning centers for subject matter core activities as well as ancillary activities (i.e. Math & fun). At the beginning of each day she plans for that day and rotates tasks with the aides.

Aides were present 4 hrs/day. Neither was a credentialed teacher. Primary responsibilities for aides were recording grades, collecting monies for lunch; supervising children's work; and providing information to the teacher on specific behavioral work issues for children. Occasionally the aides also did original instruction and diagnosing of student learning needs.

MICA in this class: Set-up & Management: Teacher and aides exclusively set up materials; Aides cleaned up.

Facilitation: Teacher worked intensively with students from 1 or 2 activities during a period. Students rotated through the activities on an assigned basis. Aides also supervised 1-2 activities each.

Emphasis on Worksheets: There was a box where children turned in their worksheets each day--once completed. This box was remarked upon by the teacher and whether a student turned one/some in for that week was checked; completion of a worksheet before proceeding to the next activity, however, was not a routine which the teacher intervened in.

teacher and at least 1 aide understood the activities very well and had little trouble with them. The second aide was very quiet and it was not clear how well she understood them as a whole; but the one she was working with at that moment she understood by virtue of the teacher's explanation, at least.

Use of Spanish: Spanish was used regularly to the group as a whole and occasionally to individuals.

School Profiles (School C) 3rd Grade

Overall: The school had 1 teacher and two aides participating in MICA. One teacher and one of the aides were trained in the MICA pre-year training. The SIP aide was not trained. The SIP aide also resented the time she had to spend on MICA "taking away" from her SIP work. The MICA activities were set-up and implemented in two separate spaces; the primary classroom and an empty room down the hall from the main classroom.

SES data: 17% were awarded free lunch or reduced lunch in this class (Prin letter)

Classroom Info: (TQ pre MICA) There is no particular criterion upon which children are assigned to this class. There was no particular time for MICA; it was woven in and around Math; the whole class did not do MICA at the same time. The class was self-contained; but there was an extra room available in which to set up MICA. Who implemented the activities in which room was/or seemed to be determined by the activity type. From the records, for the target children in this class absenteeism ranged from 4-18 days, as of April 1, 1980 2 children were out 4 days; 1 child out 5 days; 4 children were out 8-11 days; and 1 child was out 18 days.

Teacher Info: (TQ pre MICA) The teacher had 6-10 years teaching experience. She did not speak Spanish; although she had two years of Spanish in college and additional Spanish in high school. The one SIP aide also did not speak Spanish; the other aide spoke mostly Spanish and little English. This other aide was a school administrator from Chile. The teacher had experience with learning centers in the past, as a supplement to her regular teaching/learning program.

The aide(s) were present for three hours. There were no primary, set responsibilities for the aides. Tasks were rotated, and everybody did a little teaching, a little clerical work, a little diagnostic work, a little supervising of students, etc.

Set up & management: Aides set up (and cleaned up) the activities before or at the beginning of the MICA periods (and at the end).

Facilitation: Teacher wandered around the main classroom and supervised as needed; the aide took a group in the spare room and worked with them on 4 or so activities; the other aide worked with an activity in the main room.

Emphasis on worksheets: There was some emphasis; students often had to finish them at their desks before handing them into the aide or teacher. There was no sign-off procedure, but everybody was aware of them.

Use of Spanish: Spanish was never observed in use by the teacher to either group or individuals; by the aide it was occasionally in use to individuals and only infrequently in use to a whole group.

Degree of Understanding: Teacher and SIP aide moderate to lower; Spanish speaking aide Moderate

Overall: This school had a consistent teacher and aide during the activities. Both the teacher and the aide were trained during the MICA pre-service sessions.

SES: 84% were awarded free or reduced lunch in this class. (Prin Letter)

Classroom Info: (TQ pre MICA) There is no particular criterion upon which this class obtained students. The classroom was self-contained, and no outlets for water; it was in a portable.

Absenteeism ranged from 2 to 19 days out, for the target kids, as of 4/1/80. Five children were out for 2 to 4 days; three children were out 17 to 19 days.

Teacher Info: (TQ pre MICA) This teacher had 1-2 years of previous teaching and experience. Both she and the aide spoke Spanish fluently. The teacher had used learning centers previously in core areas of science and language arts.

The aide was present for 6 hrs/day. The primary responsibilities for the aide were supervising student work and clerical tasks of collecting lunch monies, preparing materials and recording student grades. Occasionally the aide also presented lessons to small groups and diagnosed student learning needs. The aide never provided large group instruction. Tasks were rotated as needed, based on standard operating procedures and teacher-teacher aide consultation.

MICA in this class: Set-up & Management: Students set up and cleaned up the activities at the beginning (and end) of the period.

Facilitation: Both teacher and aide roamed and facilitated as needed--either they noticed an issue or the student came up to them and requested help.

Emphasis on worksheets: Students were responsible for showing the completed worksheet to the teacher before proceeding to the next activity; and the teacher or aide checked it over then and there.

Degree of understanding: Teacher seemed to have a good grasp of the math activities and some of the science activities. On the whole she understood the principle behind the activities and how to do them. The aide seemed a little less clear but had a good understanding nevertheless.

Use of Spanish: Both teacher and aide used Spanish regularly to the students individually and as a whole group.

Other: This was primarily a student run experience. The teacher served as a structurer, facilitator and consultant. Teacher occasionally had group introductions where they went over assignment to activity centers and problems with the activities.

Overall: Had a teacher switch during the course of the curriculum. The first teacher went through the MICA training session. The second teacher did not. She got some individual attention from the project coordinator and staff. The aide, who had bben trained in the MICA session earlier and who had worked closely with the first teacher was able to help. The first teacher worked with the students through approximately week 6.

SES data: 61% of the students in that class were on free or reduced (Prin File) lunch.

Classroom Info: (TQ pre MICA) Students are assigned to this class on a LES basis. Both teachers reported trouble getting and keeping order. This was also noted by the observers. Class was in an open space setting with special noise problems to the extent that the school had called in a consultant to work with them on dealing with the issues.

From the records, we can get some idea of an absentee rate only for the target kids. The range was from 3 to 20 days; 2 children were out 3-4 days; 4 children were out 6-10 days and 2 children were out 15-20 days.

Teacher Info: (TQ pre MICA) The first teacher had 6-10 years experience previous to MICA. She spoke Spanish. She had experience with learning centers as a source of reinforcement for students. Wanted centers with structure; not a free-educational environment. Plans one day ahead for the next days work.

The aide was present for 6 hours a day in her class. The aide was not a credentialed teacher. Most common work modes for the aide previous to MICA were supervising student work and feeding information to the teacher on specific behavioral work issues for children in the class. The aide never asked to diagnose student needs. The aide occasionally recorded grades or collected lunch monies; or prepared a lesson in ESL for a subgroup of children; never did other original instruction.

MICA in this class: Set-up & Management: Usually done by teacher and aide. Sometimes students helped. Aides and students cleaned up.

Facilitation: Teacher roved and monitored; aide was usually stationery for a given activity. Students decided where to go next by what was free or special assignment.

Emphasis on worksheets: Had to finish before proceeding; they were not signed off upon however.

Degree of understanding or trouble with activities: First teacher had some trouble, but generally understood what had to do; second teacher had much more trouble.

Use of Spanish: Spanish was used regularly by the teacher and aide to the whole group and individuals in the class.

Other: The first teacher was enthusiastic about the activities byt appeared overwhelmed about the amount of work they entailed. This was only increased when the second teacher came in. Overall, both teachers were enthusiastic about the project. They wanted a quality experience and student cooperation.

Overall: Had two aide switches, both right at the beginning of the year; the same teacher during the course of the year, however. Teacher had been trained in good Spanish; aide (final aide) did not speak Spanish. The teacher participated in the training workshop; the final aide had not participated (the initial one had).

SES data: (Prin) 74% of the students in this class were on free or reduced lunch

Classroom Info: (TQ pre MICA) Students are assigned to this class on a LES basis, however, some FES students are also added to the class on principle. Teacher very particular about who worked her students; initially this created special project problems later (once trust built up) there was not a problem. Classroom was self-contained

From the records (as of 4/1) for the target kids, absenteeism ranged from 0-28 days out: 4 children were out 0-4 days, 1 child was out 7 days; 1 child was out 12 days; 1 child was out 17 days; and one child was out 28 days.

Teacher Info: (TQ pre MICA) This teacher had 11-20 years of teaching experience. She speaks Spanish; although she may not be native to it, she speaks it well. She has had experience with learning centers for core learning: language arts and social studies. At the beginning of the year she figures out the general roles for the teacher and the aide.

The aide was not a credentialed teacher. She was present for 5 hours/day. The aide (final one) did not speak Spanish. Principle responsibilities were all except clerical which were done occasionally.

MICA in this class: (Observers recorded comments) Set-up & Management: Usually done by Teacher, Aide + 1 or 2 students during latter part of lunch before MICA began; kids & aide cleaned up at the end of the period.

Facilitation: Teacher began each MICA with a group session (also ended each session with a group meeting) in a circle where discussed activities, interesting findings and special problems. Teacher generally roved and monitored helping as needed. If there was a particularly difficult task, they often worked intensely with that group; aide worked with usually a selected activity or activities; sometimes aide would rove.

Emphasis on worksheets: Worksheet emphasis was not verbalized during the MICA period; nor was there a marked place in the class to turn them in. Kids did work consistently on them, however, and they seemed to be a goal for completion of the activity.

Degree of understanding or trouble with the activities: Teacher had a clear understanding of the activities; the understanding of the aide was very good also.

Use of Spanish: Teacher used Spanish regularly to the whole group and to individual children; aide did not speak it.

Other: This class was almost entirely student run with the teacher acting as a consultant and facilitator. Teacher was very enthusiastic about the materials and the project.

Overall: This school had a teacher and an aide, who were consistent over the course of the activities. The teacher was bilingual in E/S; the aide only spoke English. The teacher participated in the pre-year MICA training session; the aide did not participate.

SES data: (Prin letter) 81% of the students in that class were on free or reduced lunch.

Classroom Info: (TQ pre MICA) Students were not assigned to this class on any specific criterion. Class was in an open space setting; noise was a consideration; also a consideration was the attractiveness of the activities to the other classes of students in the pod not using them. The fact that students were intrigued by the activities they saw going on in this class irked (or seemed to irk) the other non-participating teachers in this pod. This was not a serious problem, however.

The records show an absenteeism rate for the target children in thi class (as of April, 1980) which varies from 1-24 days; 3 students had been out 1-4 days; 3 students were out 10,11 days; and two students were out 20-24 days.

Teacher Info: (TQ pre MICA) This teacher had 1-2 years of experience with migrant programs before the MICA experience. She spoke Spanish. She had experience with learning centers and with science; that was the way in which she had handled the migrant programs (i.e., with OBIS--Outdoor biology instruction in Spanish). She plans that morning for the day.

The aide was present for 6 hours; this aide did not speak Spanish. Tasks were rotated. Primary responsibility involved presenting lessons to small groups or individual students; supervising student work; recording grades and collecting monies (but not preparing materials); and providing information to the teacher on specific student behaviors. Occasionally the aide also provided large group instruction. The aide never would diagnose for individual student learning needs.

MICA in this class: Set-up & Management: 2 or 3 kids set up and cleaned up the activities during the recess before MICA.

Facilitation: Teacher roved and monitored and answered questions or extended as need be; aide sometimes roved and monitored; sometimes watched a particular activity; and often stayed on sidelines.

Emphasis on worksheets: Very little emphasis; no sign off; no place to put them underscored.

Use of Spanish: Teacher regularly used Spanish both to individuals and to the group as a whole; aide did not know it.

Degree of understanding of activities: Teacher understanding of both activities, management concepts and some of the learning concepts was very high; aide's seemed very low. Teacher could tell at a glance it seemed, why an experiment wasn't or was working.

School Profiles (School O) 2/3 Grade

Overall: This school had one aide and one teacher, consistently through the course of the activities. Both spoke Spanish. Only the teacher participated in the pre-year MICA training session, because the aide's family was sick.

SES data: 93% on free lunch or reduced lunch
(teacher)

Classroom Info: Students are not assigned to this class on the basis of any special criterion. Classroom was in open space. This did not seem to cause any special problems or benefits. The only problem was that there was a rug and the activities using clay and the one where they had to mark the footsteps with chalk greatly annoyed the janitor who had to clean up the rugs later. This seemed to be enough of an annoyance that future activities involving clay or chalk markings will probably be eliminated in their use.

Records were not available to us at the school level or classroom level concerning absenteeism. The teacher made an estimate of the amount of absense for each of the target children, however; according to this estimate, as of April 1, absenteeism ranged from 0 to 5 days out. Four children were never absent, 2 children were absent approximately once a week or 25 days. One child was out once or twice a week, totalling approximately 35 days out.

Teacher Info: (Pre MICA TQ) This teacher had 1-2 years of previous teaching experience. She spoke Spanish fluently. She had experience with learning centers in core subject areas (e.g. reading) and thought they were adequate. Generally the teacher decides alone what is to be done in the class or there is a standard operating procedure. The aide does not have any primary responsibility. She rotates supervising students, doing clerical tasks, and serving as an informant for the teacher on particular student behaviors. The aide is never expected to plan or teach a lesson or to diagnose student needs.

The aide was present for 6 hours a day. She was not a credentialed teacher.

MICA in this class: (Observer recorded) comments Set-up & Management: Usually done by the aide before the actual period; students would clean up themselves after the period was over. Sometimes the children helped set-up too.

Facilitation: Teacher roved and helped as needed. Often she stayed more or less in the center and children came to her. The aide wandered also; sometimes she was stationery with a particularly difficult experiment to help the kids get through.

Emphasis on worksheets: There was moderate amount of emphasis on the worksheets. Students worked at center tables to get the worksheets completed; they then handed them into the teacher; the teacher did not go over them.

Degree of understanding or trouble with the activities: Both teacher and aide had an excellent understanding of how the science activities worked. Whether there was an understanding of the purpose or concept behind the MICA activities seems questionable. Getting through the activities seemed to be a theme.

Use of Spanish: Both teacher and aide used Spanish regularly with both individuals and the group as a whole.

Other: This class was almost entirely student run. There was not any problem for a student in figuring out what to do next or where to go next; a standard operating procedure had been worked out that worked.

School Profiles (School W) 3rd Grade

Overall: This school had a consitent teacher and aide during the activities. Both the teacher and the aide participated in the pre-year MICA training session. This school was very slow in implementing the activities, however, and seemed to feel there were great management problems. The teacher split up when she used to MICA to fit into a number of different pockets during the day and was not consistent when she used the activities.

SES: (Prin) 85% were on reduced or free lunch and qualified for AFDC

Classroom Info: (TQ pre MICA) There was a bilingual criterion used to determine the students for the class. LES. The class was self-contained.

Absenteeism ranged from 0 to 23 days for the target students here, as of 4/1/80: 1 student was never absent; 1 student was absent for 5 days; 3 students were absent for 7-9 days; 1 student was absent for 14 days; 1 student was absent for 23 days.

Teacher Info: (TQ pre MICA) This teacher had 6-10 years of teaching experience. Both she and her aide spoke Spanish. She had had experience using learning centers previously in curricular areas.

The aide was present 51/2 hours a day. They decided at the beginning of the year how they would divide up the tasks. Primary responsibilities for the aide were planning lessons for the whole group; supervising work clerical tasks such as collecting lunch monies, and feeding information to the teacher concerning particular student behaviors. Only occasionally would the teacher aide present lessons or diagnose student learning needs.

MICA in this class: Set-up & Management: Teacher and aide set up the activities before the actual period.

Facilitation: Often the whole class did one activity which the teacher demonstrated. At these times the aide did not participate except as requested by the teacher. At the beginning of the activities, students worked on their own and the teacher worked primarily with one learning center and the aide with another. Teacher and aide had to sign off on worksheets, so their work with a learning center was generally fitful.

Degree of understanding: Both teacher and aide had a hard time understanding the activities. Neither did them at home or pre-read the panels before introducing them to the children; neither had a flare for science.

Use of Spanish: Rarely was Spanish used by either teacher or aide toward the whole group; and at most only occasionally was it used by the teacher to individuals; the aide rarely used Spanish in part because she did not interact too much, perhaps.

Other: This was primarily a teacher-run experience. The structure of the class resembled what another whole class instruction experience would be like.

APPENDIX C

MINI-TEST PART I & II

English

No. _____ Name _____

School _____ Boy _____ Girl _____

Grade _____ Condition _____ _____

Age _____

Teacher _____

Finding Out
Booklet

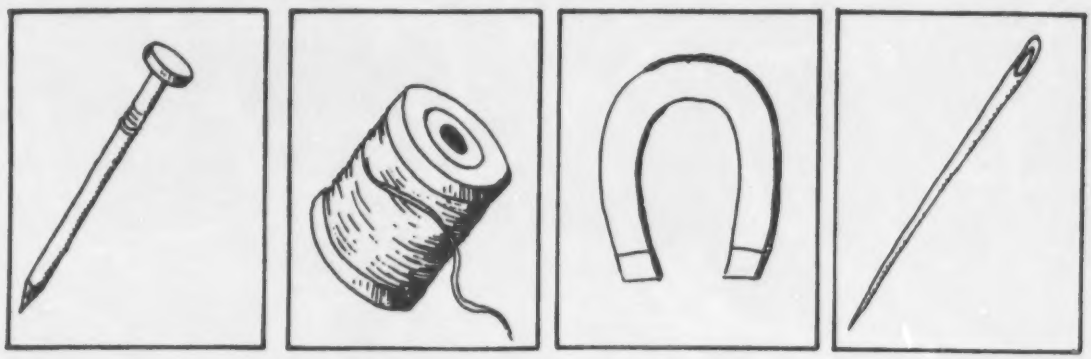
Section I _____

II _____

III _____

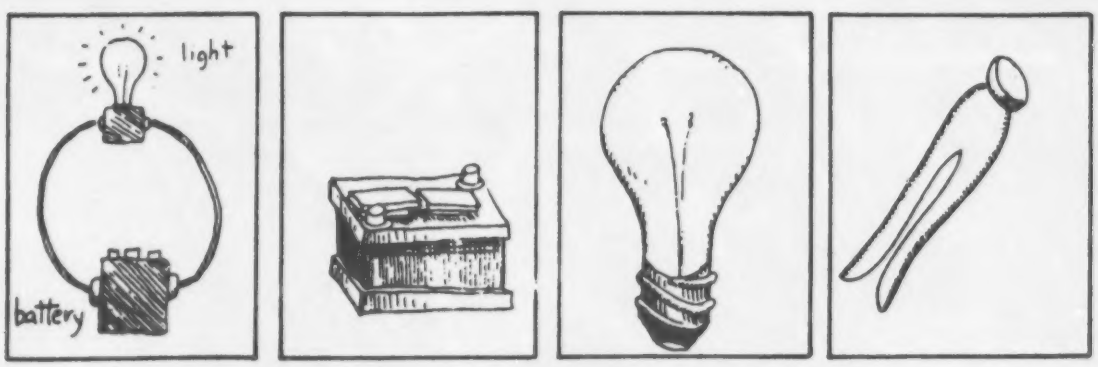
I. DIRECTIONS: Read each word. Choose the picture that means the same as the word. Put a big "X" on the picture that means the same as the word.

1. needle



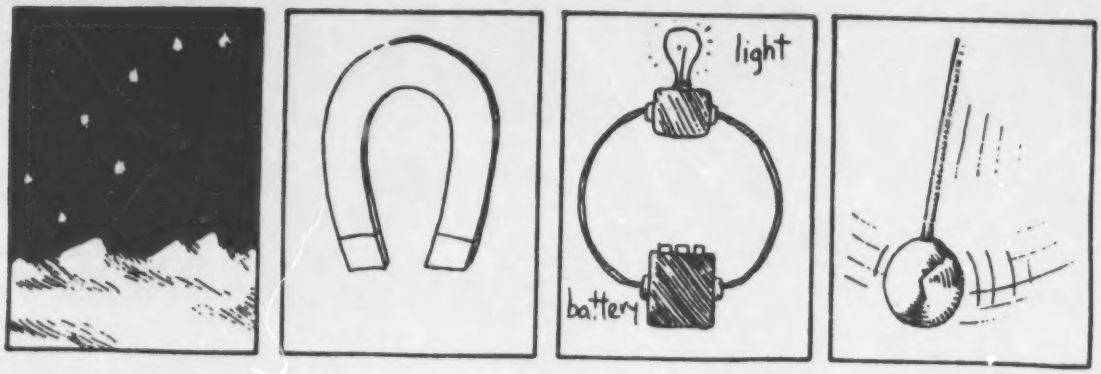
A B C D

2. circuit



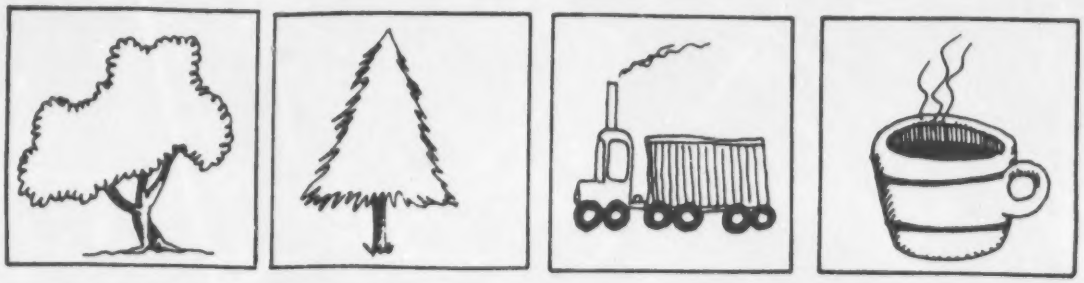
A B C D

3. constellation



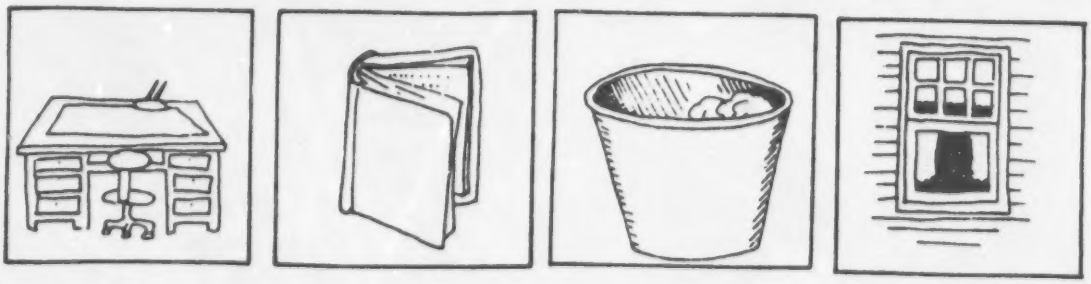
A B C D

4. symmetry



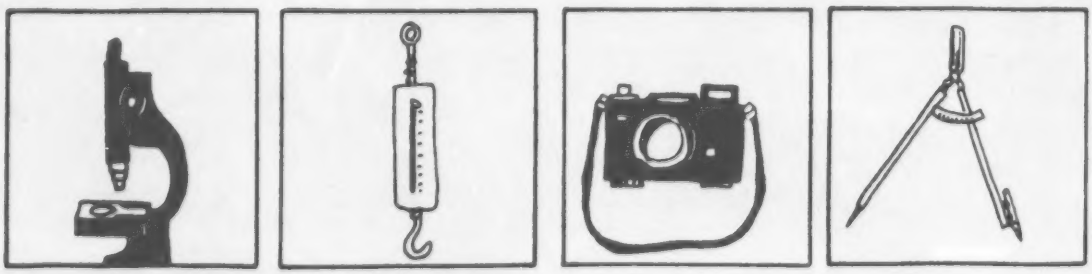
A B C D

5. circular



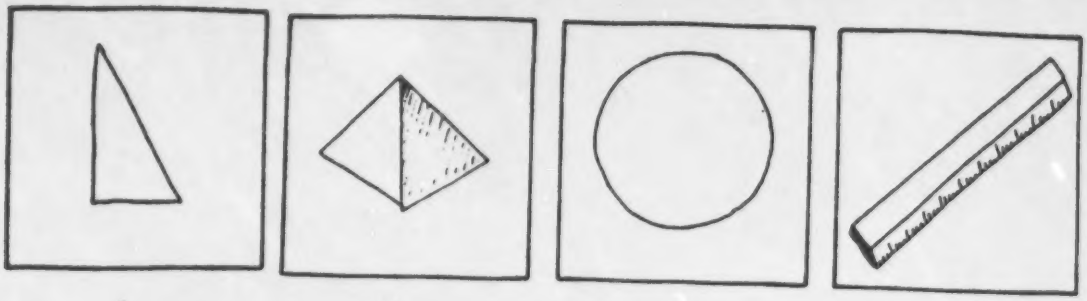
A B C D

6. compass



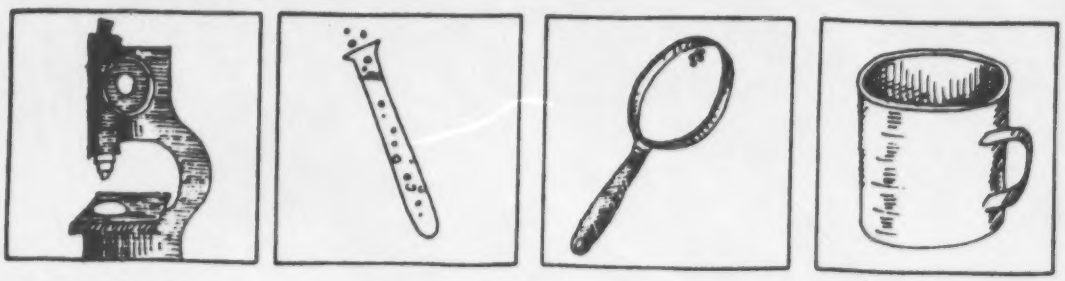
A B C D

7. polyshape



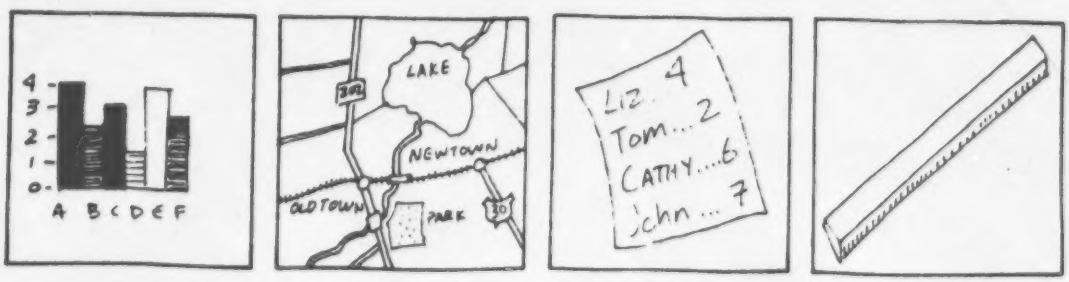
A B C D

8. test tube



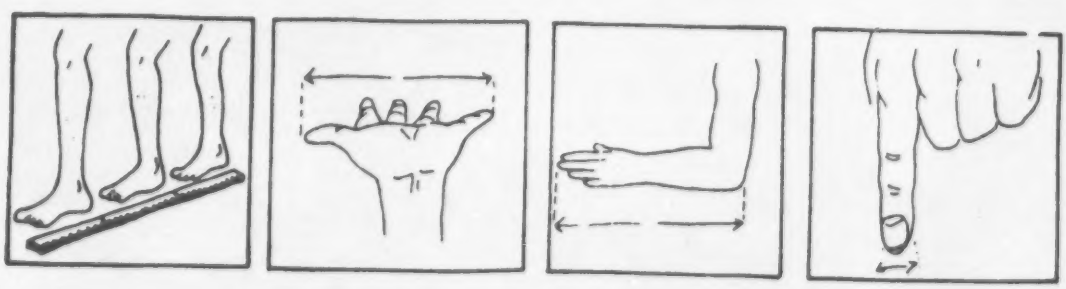
A B C D

9. graph



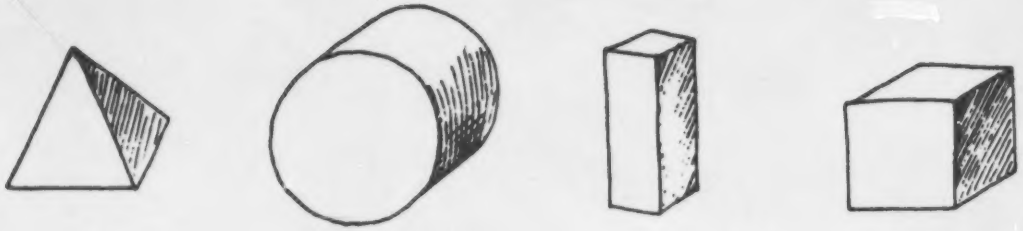
A B C D

10. span



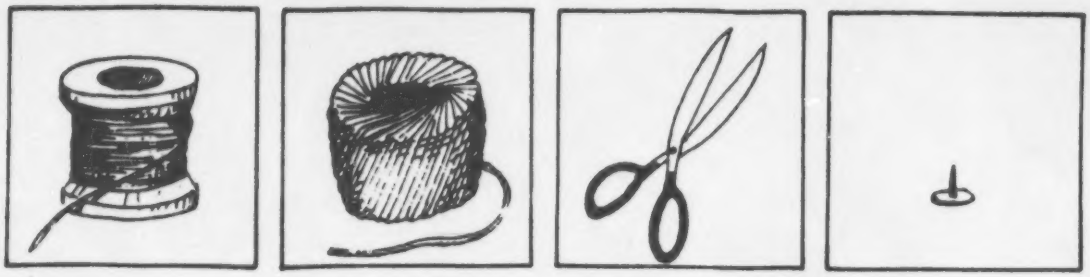
A B C D

11. cube



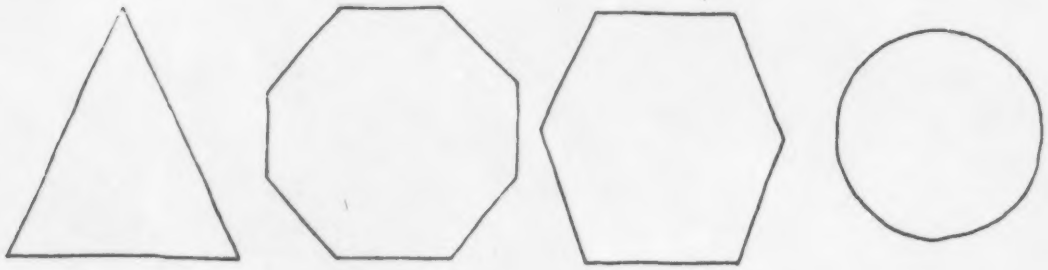
A B C D

12. thread



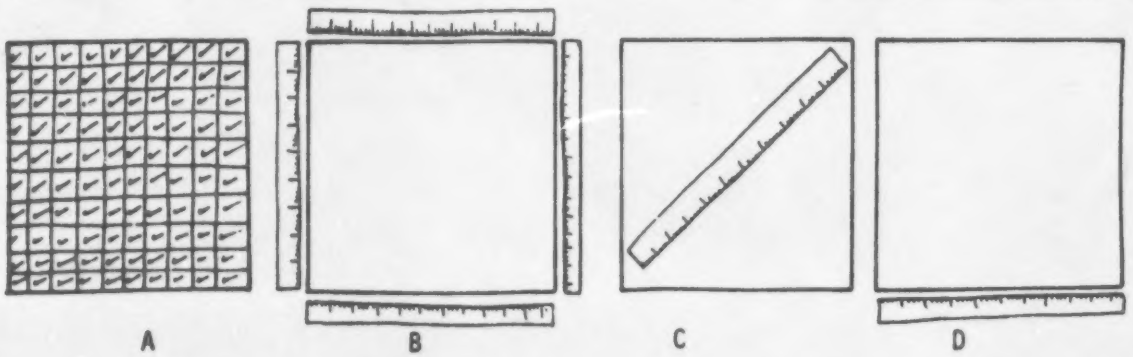
A B C D

13. hexagon



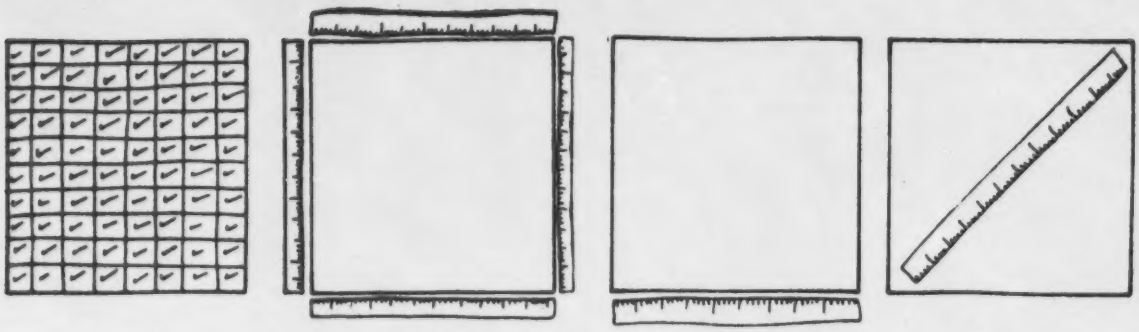
A B C D

14. perimeter



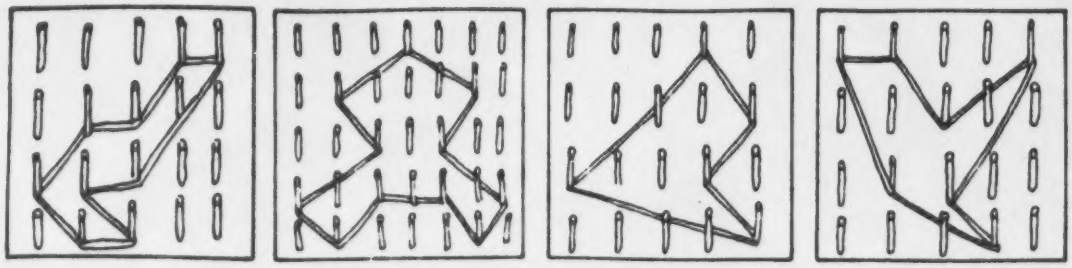
A B C D

15. area



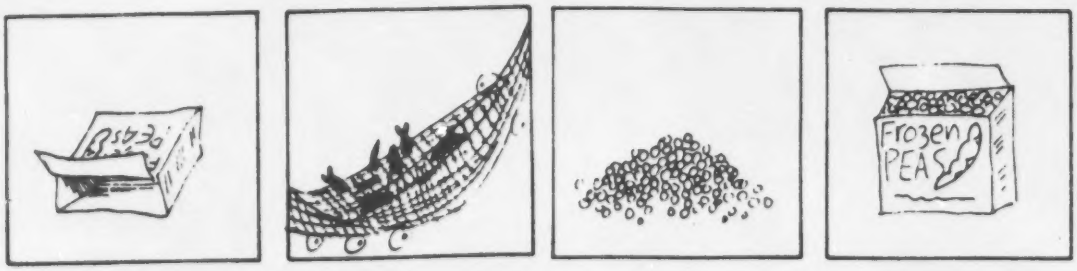
A B C D

16. symmetry



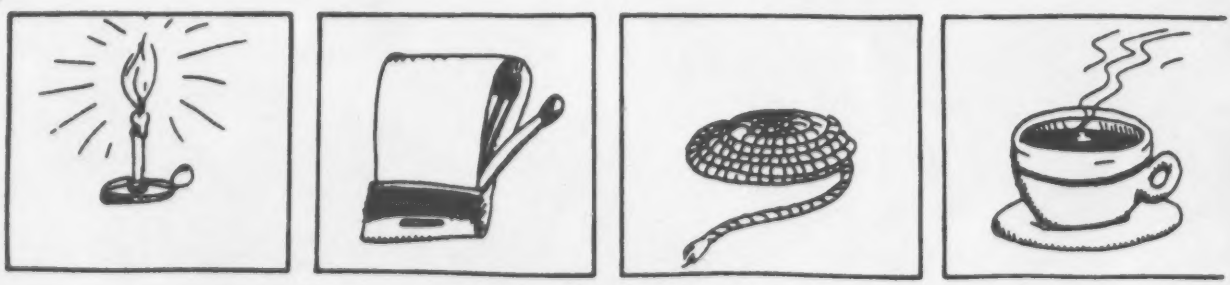
A B C D

net weight



A B C D

18. flame



A B C D

STOP

DIRECTIONS: Read each sentence. Choose the word that should finish the sentence.

1. Milliliters are useful for measuring _____.

   A. bugs

   B. milk

   C. your height

   D. your weight

2. It takes about 1 second to _____.

   A. eat breakfast

   B. play baseball

   C. close your eyes

   D. brush your teeth

3. Which of the following is a liquid?

   A. dough

   B. milk

   C. salt

   D. measuring cup

4. Carol liked to make jewelry. Her mother gave her some beads for Christmas. Carol decided to count the beads. She put them in groups of ten. Carol discovered she has 63 beads. How many groups of ten are in 63?

   A. 3

   B. 6

   C. 9

   D. 10

5. Which unit of measurement should you use to measure your height?

   A. meters

   B. decimeters

   C. centimeters

   D. millimeters

6. You should use millimeters to measure _____?

   A. your height

   B. your weight

   C. the length of your desk

   D. the length of your little fingernail

7. John guessed that his foot was six centimeters long. John's guess is _____.

   A. a test

   B. an estimate

   C. an experiment

   D. a measurement

8. Jay measured the length of his pencil. It was ten centimeters long. Ten centimeters is the _____ length of the pencil.

   A. actual

   B. guessed

   C. pretend

   D. estimated

9. Jill thought she was eighty-seven centimeters tall. When her friend measured her, she told Jill that she was really ninety centimeters tall. Ninety centimeters is Jill's _____ height.

A. actual

B. guessed

C. pretend

D. estimated

10. Liz wanted to know how long her hand was. Mary measured Liz's hand from the tip of her middle finger to her wrist. Mary measured the _____ of Liz's hand.

A. width

B. height

C. length

D. thickness

11. Ann liked to breathe on the car windows. Then she could draw pictures on them with her fingers. What was Ann putting on the windows?

A. gas

B. paper

C. crayons

D. moisture

12. Ms. Brown wanted to buy carpet for her bedroom. She needs to decide how much to buy. What will Ms. Brown need to find out?

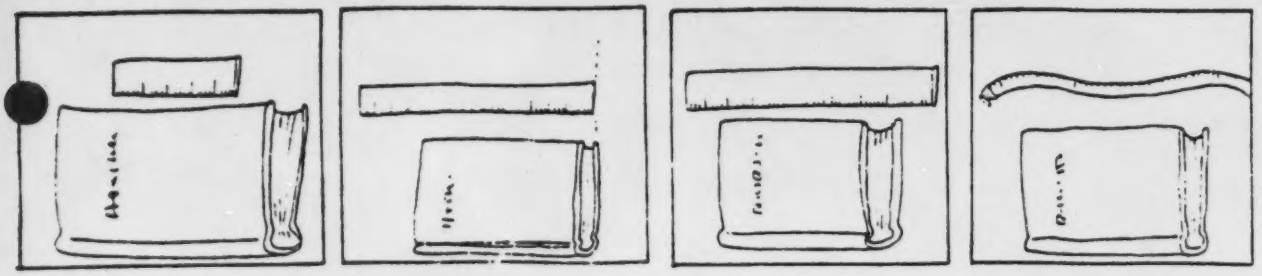
A. the area of the room

B. the perimeter of the room

C. the height of the room

D. the volume of the room

13. Which picture shows you how to make an accurate measurement?



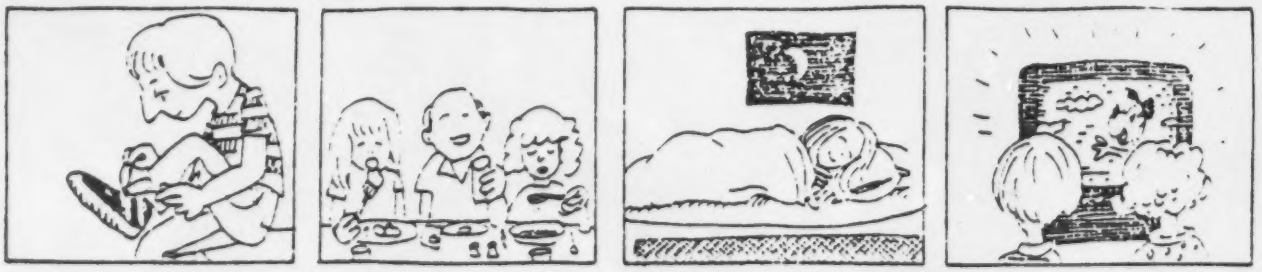
A B C D

14.

These liquids are all _____?

A. acic
B. base
C. neutral
D. poison

15.



A B C D

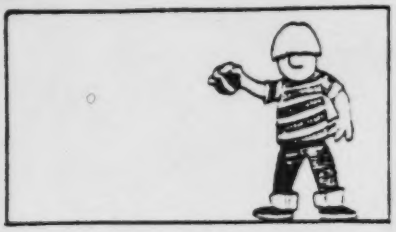
Which of the above activities takes about one minute to do?
(Circle the correct letter below)

A.
B.
C.
D.

STOP

DIRECTIONS: Look at the three pictures in order from left to right.
Choose the word that best describes what is happening.
Circle the letter next to your answer.

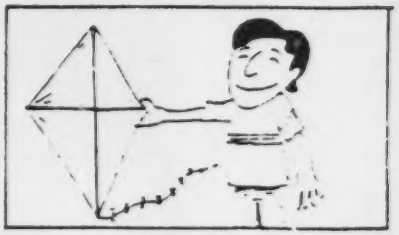
16.



Which word tells what is happening to the ball?

A. soak
B. bounce
C. arrange
D. flatten

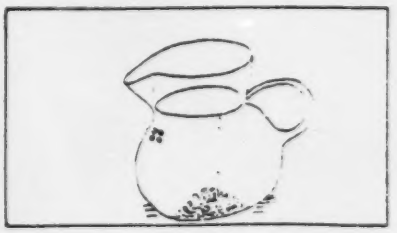
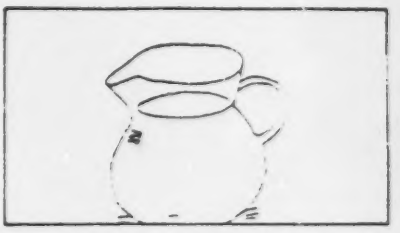
17.



The last picture shows the _____ of Jim's work.

A. pattern
B. results
C. tangram
D. constellation

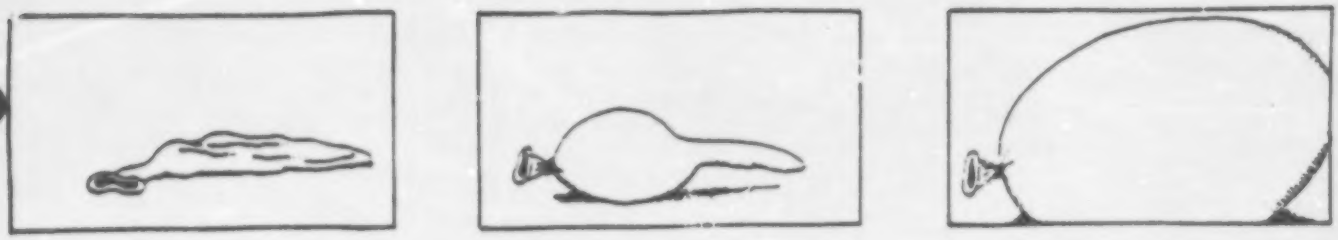
18.

What word tells what is happening?

A. boil
B. expand
C. dissolve
D. concentrate

19.



What is happening to the balloon?

A. It is expanding
B. It is condensing
C. It is being measured
D. It is being estimated.

STOP.

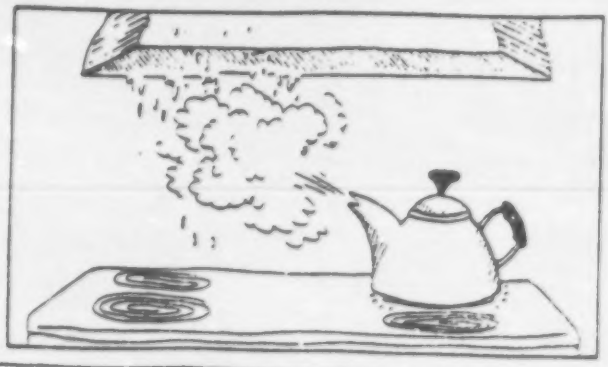
DIRECTIONS: Use the pictures to help you answer the questions.
Circle the letter next to your answer.

20. What do we call these things?

A. experiment
B. measurement
C. ingredients
D. carbon dioxide

21. What is the pot of water putting in the air?

A. acid
B. crystal
C. moisture
D. negatives



22. In the picture Judy is watching the goldfish to see if they ever touch each other. Another words for "watch" is:

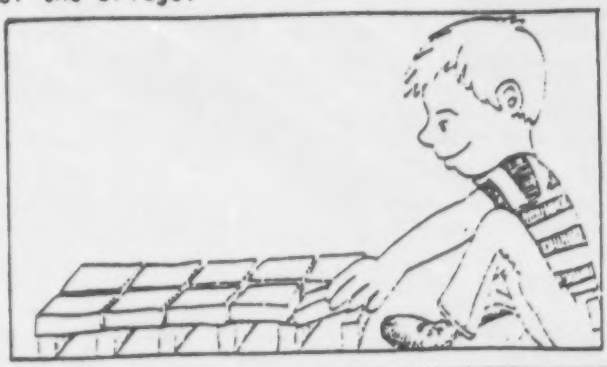
A. occupy
B. record
C. reduce
D. observe

23. Joe wants to know how caterpillars turn into butterflies. He has put a caterpillar in a jar and will watch it as it changes. How will Joe learn about the caterpillar?

A. He will shape it.
B. He will observe it.
C. He will estimate it.
D. He will crystalize it.

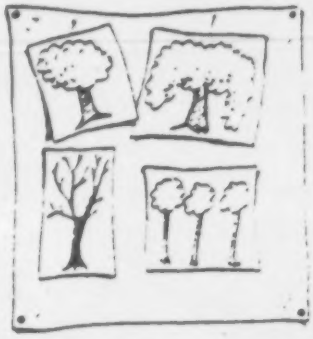
24. Tony built a bridge out of blocks. It was 5 blocks long and 2 blocks wide. We call these numbers the _____ of the bridge.

A. height
B. symmetry
C. materials
D. dimensions



25. Julie had drawn several pictures of trees. She decided to glue all her pictures on one large piece of cardboard. What was Julie making?

A. poster
B. pattern
C. pentagon
D. perimeter

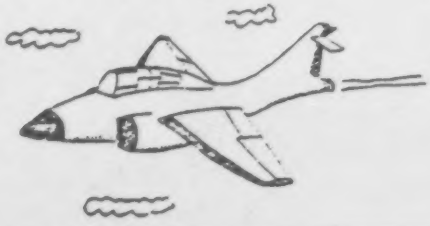


26. To make a shadow you must have _____.

A. light
B. shoes
C. the sun
D. a camera

27. The airplane is flying in a certain _____.

A. shadow
B. distance
C. solution
D. direction



28. When we say, "Leaves grow up and roots grow down," we are saying they each grow in a certain _____.

A. shadow
B. distance
C. solution
D. direction

29. Tom is pouring himself a glass of soda pop (such as coke). It looks like he poured too much. We might say, "The drink has _____."

A. floated
B. reflected
C. separated
D. overflowed

Jill's grandmother was having trouble reading the newspaper. She said the letters were so small she could not see them. To make the letters look larger Jill's grandmother needs glasses which:

A. trace
B. magnify
C. reflect
D. contract

31. José was playing with a rubberband. He pulled on the rubberband and it make a sound. The sound was caused by a _____.

A. degree
B. balance
C. swallow
D. vibration

32. Susan and Sandra were playing together. Susan's mother had an idea of something to do. She mixed soap flakes and water together. Susan and Sandra used this mixture to blow soap bubbles. Another word for <u>mixture</u> is:

A. location
B. solution
C. vibration
D. prediction

33. The weatherman said it will probably rain tomorrow. He is making a:

A. quantity
B. prediction
C. structure
D. comparison

34. Joe's family went on a hike to a lake. Joe looked in the lake and saw himself. Sometimes lakes are like mirrors. They both:

A. break
B. focus
C. freeze
D. reflect

STOP.

DIRECTIONS: Read each story. Answer the question.
Circle the letter next to your answer.

35. Sharon's plant was dying. She did not know why. She thought it might need more water or maybe it needed more light. First, Sharon decided to try watering the plant more often. After two weeks the plant was still sick. Sharon then decided to move the plant to a sunnier window. In a week the plant looked much better. To find out what was wrong with her plant, what did Sharon do?

A. a graph
B. a recipe
C. a measure
D. an experiment

36. Mr. Jacob's class was doing exercises every afternoon. Today he wanted to teach everyone a new exercise. To do this exercise everyone would need to find one other person to work with. Amy and Beth decided to work together. We would call them _____.

A. circular
B. partners
C. identical
D. scavengers

37. Jean and Susan decided to ride their bicycles to the drugstore. They met at Susan's house and talked about their bikes. Jean liked Susan's bicycle because it was red and had a horn. Jean's bike was blue and did not have a horn. Susan liked Jean's bike because it had a basket and a soft seat. What were the two girls doing with their bikes?

A. tracing them
B. comparing them
C. measuring them
D. diagraming them

38. Mr. Rodriguez needed to fix the roof over his house. He was going to have to buy a ladder to get up on the roof. Before he went to the store he went outside and looked at his house to see how tall it was. Mr. Rodriguez did not have a tape measure but he guessed that he would need to buy a twenty foot ladder. What do you think Mr. Rodriguez did?

A. record
B. measure
C. estimate
D. stretch

39. Joey's family got a new dog which they named Tippy. Joey wanted to keep Tippy in the house at night so he wouldn't be cold, but Joey's dad said the dog had to stay outside all the time. Joey decided to build a house for Tippy. His father gave him some wood and tools. The first thing Joey needed to do was decide how big the dog house would need to be for Tippy to fit inside of it. How should Joey do this?

A. measure Tippy
B. shorten Tippy
C. build the house around Tippy
D. build a house and hope it is large enough

40. After school Jill went over to Cecilia's house to play. When it came time for Jill to walk home, Cecilia's mother was worried that it would soon start raining. She decided it would be a good idea to let Jill wear Cecilia's raincoat to walk home in. How did Cecilia's mother decide that Jill and Cecilia were approximately the same size?

A. she outlined
B. she recorded
C. she estimated
D. she magnetized

---

41. Tom and Alfredo were making chocolate pudding. The directions on the box told them how much milk to use. Tom dumped the pudding in the bowl. What should Alfredo do before he puts the milk in the bowl?

A. heat it
B. drink it
C. weigh it
D. measure it

---

42. Ann needed a flashlight to see if her cat was under the house. When she tried to turn the flashlight on, it did not work. Ann was not sure what was wrong with the flashlight. Maybe it needed a new light, or maybe it needed new batteries. To find out, Ann first tried new batteries. The flashlight still did not work so Ann decided it must need a new light. To discover what was wrong with the flashlight, what did Ann do?

A. a graph
B. a recipe
C. a measure
D. an experiment

END OF SECTION II

MINI-TEST PART I & II

Spanish

No. _____ Nombre _____

Escuela _____ Niño_____ Niña_____

Grado _____ Condición_____

Edad _____

Maestro/a _____

LIBRITO PARA
DESCUBRIMIENTO

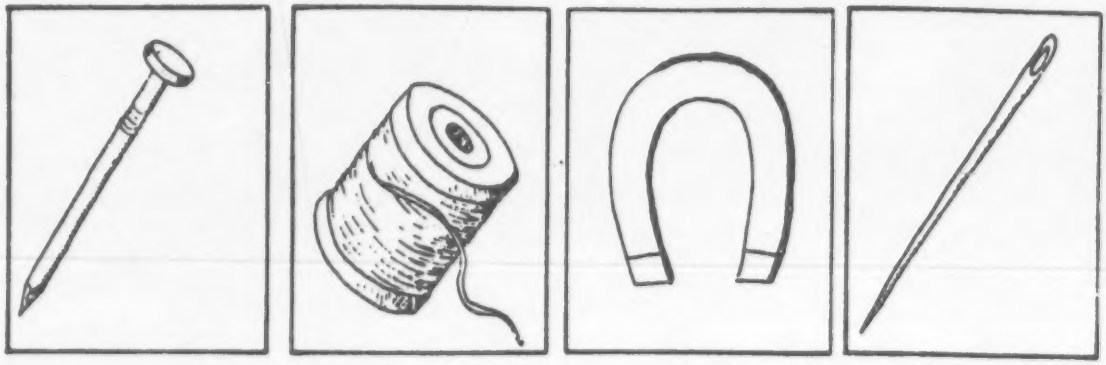
Parte I _____

II _____

III _____

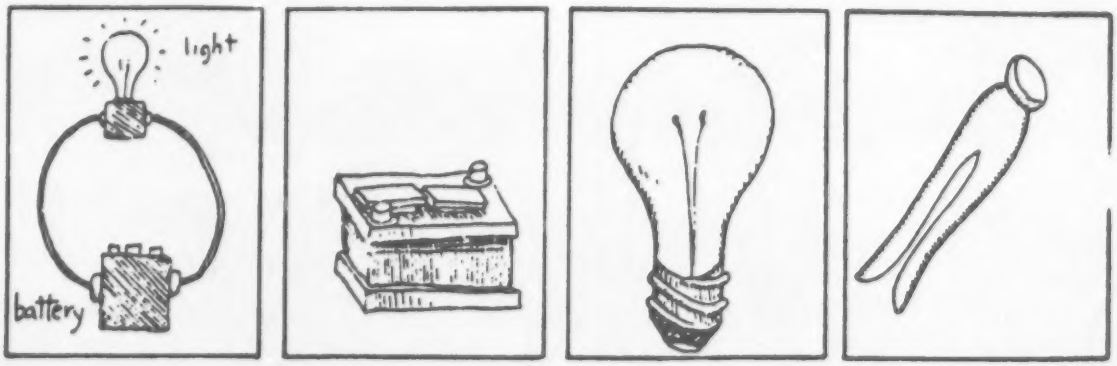
I. DIRECCIONES: Lee cada palabra. Escoje el dibujo que quiere decir lo mismo que la palabra. Pon una "X" grande en el dibujo que quiere decir lo mismo que la palabra.

1. la aguja



A B C D

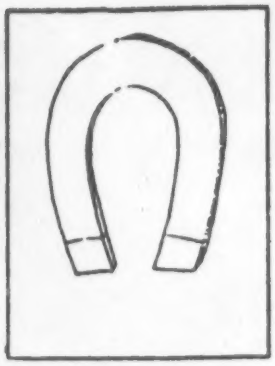
2. el circuito



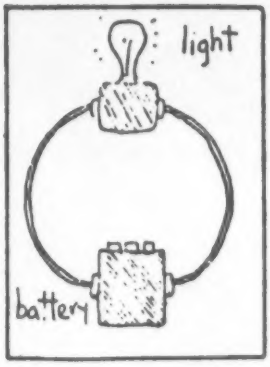
A B C D

3. la constelación

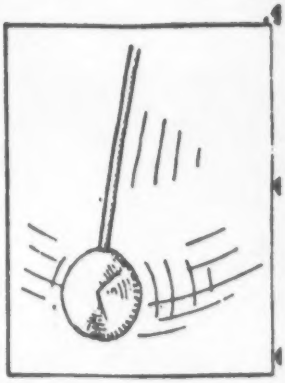
A



B



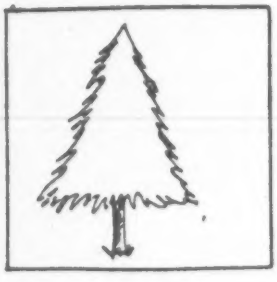
C



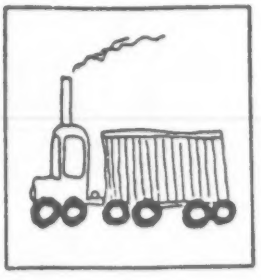
D

4. la simetría

A



B

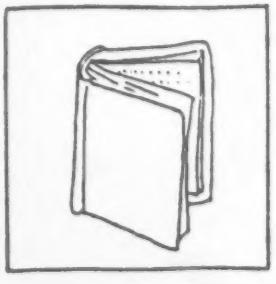


C

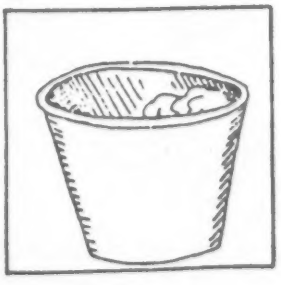
D

5. circular

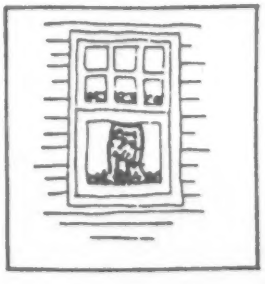
A



B



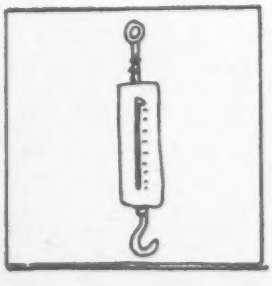
C



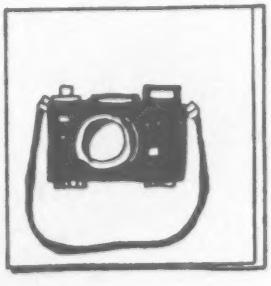
D

6. el compás

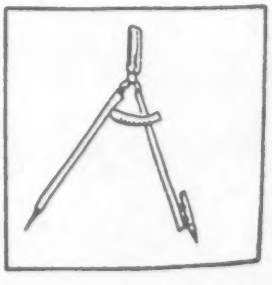
A



B

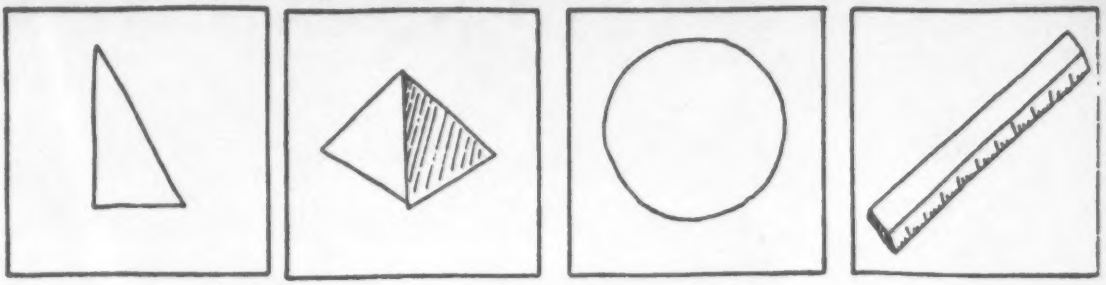


C



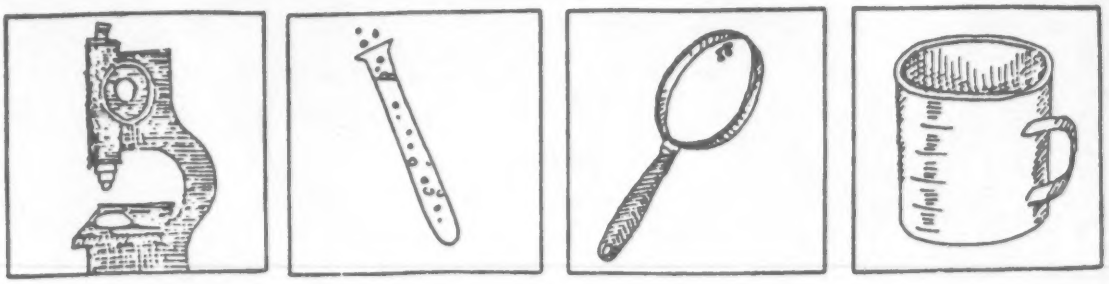
D

7. la poliforma



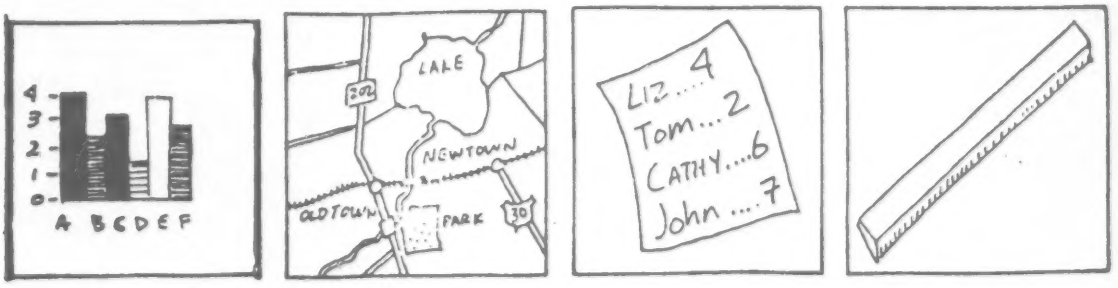
A B C D

8. la probeta



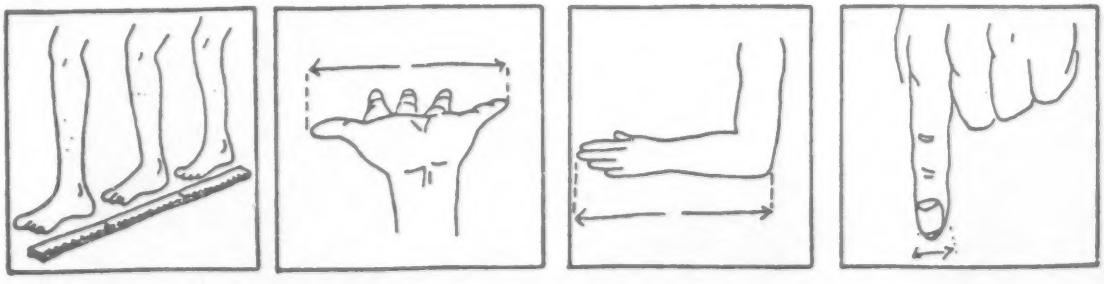
A B C D

9. la gráfica



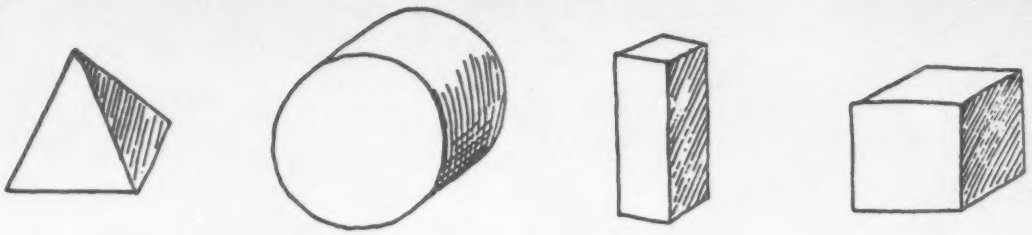
A B C D

10. una palma



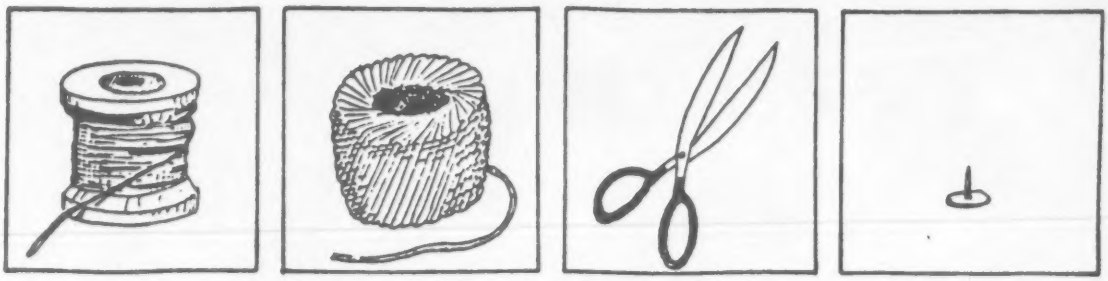
A B C D

11. el cubo



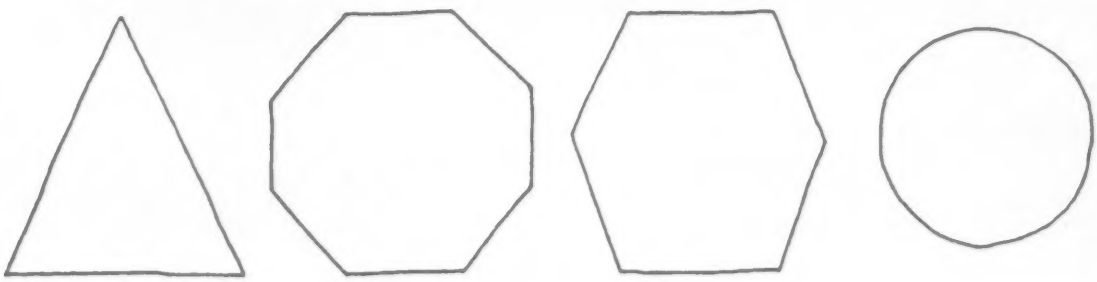
A B C D

12. el hilo



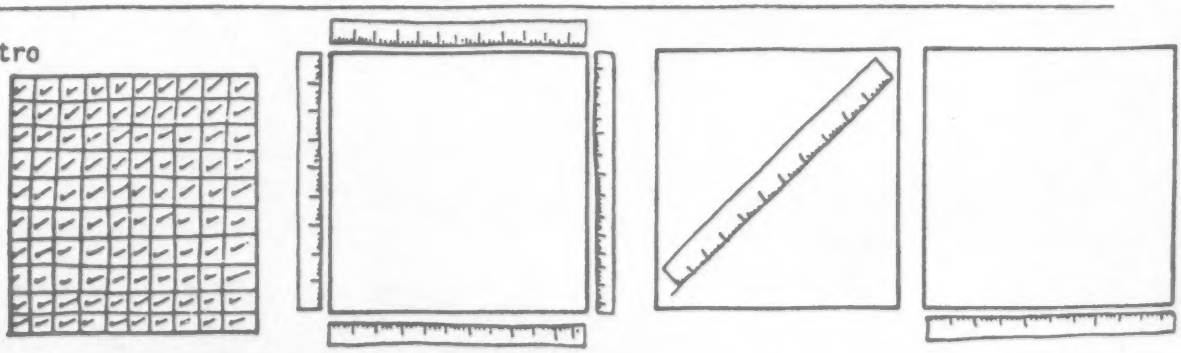
A B C D

13. el hexágono



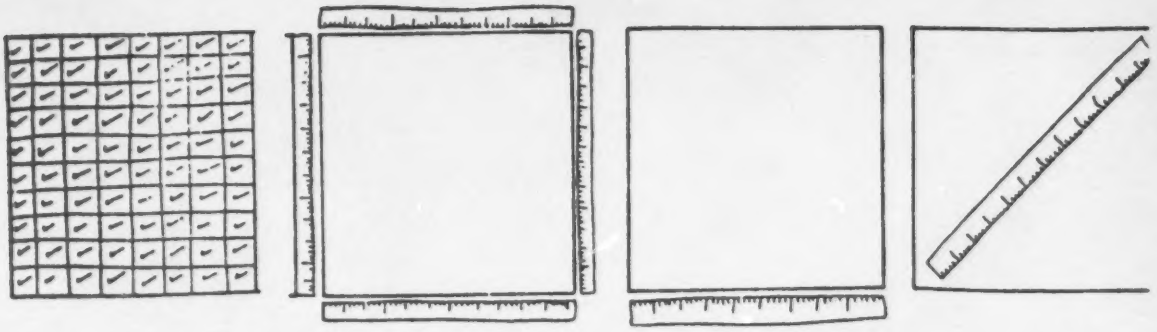
A B C D

14. el perímetro



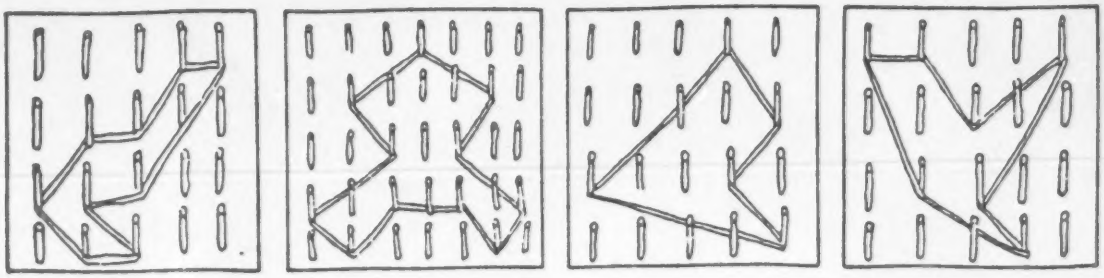
A B C D

15. el área



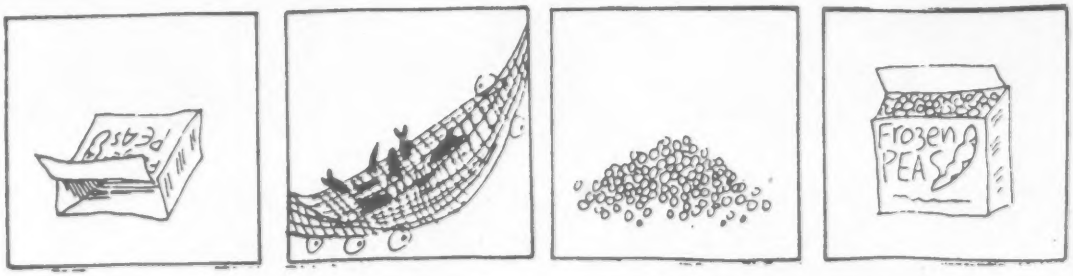
A B C D

16. la simetría



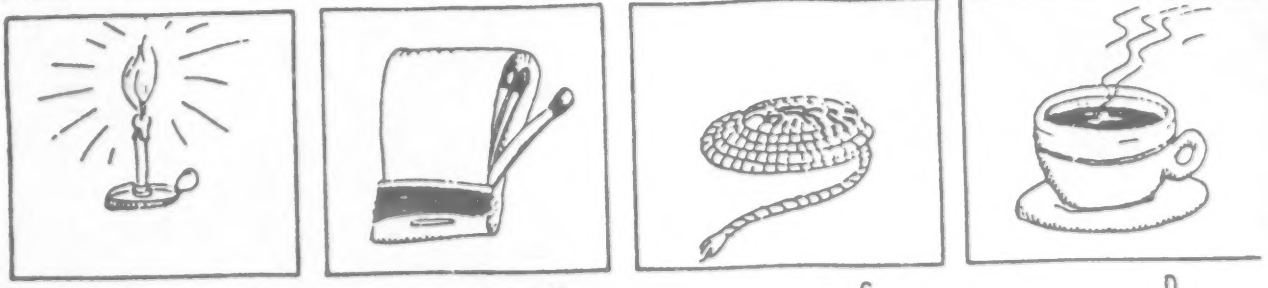
A B C D

. el peso neto



A B C D

18. la llama



A B C D

II. DIRECCIONES: Pon un círculo alrededor de la palabra o las palabras que mejor contesta la pregunta.

1. Los mililítros son útiles para medir _____.

   A. insectos

   B. la leche

   C. tu altura

   D. tu peso

2. Uno se tarda como un segundo en _____.

   A. desayunar

   B. jugar béisbol

   C. cerrar los ojos

   D. lavarse los dientes

3. De los siguientes, ¿cuál es un líquido?

   A. masa de harina

   B. la leche

   C. la sal

   D. una taza para medir

4. A Carol le gusta hacer joyería. Para Navidad, su mamá le regaló unas cuentitas. Carol decidió contarlas. Las juntó en grupos de 10. En total ella contó que tenía 63. Cúantos grupos de 10 hay en 63?

   A. 3

   B. 6

   C. 9

   D. 10

5. ¿Qué unidad de medidas deberás usar para medir tu altura?

   A. metros

   B. decímetros

   C. centímetros

   D. milímetros

6. Deberías de usar milímetros para medir _____.

   A. tu altura

   B. tu peso

   C. lo largo de tu escritorio

   D. lo largo de la uña de tu dedo chico

7. Juan adivinó que su pie medía seis centímetros. Su adivinanza la llamamos _____.

   A. un examen

   B. una estimación

   C. un experimento

   D. una medida

8. Jay midió lo largo de su lápiz. Medía 10 centímetros. 10 centímetros es el largo _____ del lápiz.

   A. real

   B. adivinado

   C. aprendido

   D. estimado

9. Jill pensó que medía 87 centímetros de altura. Cuando su amiga la medió, le dijo que en realidad medía 90 centímetros. La altura _____ de Jill son los 90 centímetros.

A. real

B. adivinada

C. fingida

D. estimada

10. Liz quería saber qué largo tenía su mano. Mary se la midió desde la punta de su tercer dedo, hasta la muñeca. Mary midió lo/la _____ de la mano de Liz.

A. ancho

B. alto

C. largo

D. grueso

11. A Ana le gusta dejar su aliento en las ventanas de los carros porque así puede hacer dibujitos con su dedo sobre la ventana. ¿Qué es los que estaba dejando el aliento de Ana sobre el vidrio de la ventana?

A. gas

B. papel

C. crayolas

D. la humedad

12. La Srta. Brown quería comprar una alfombra para su dormitorio. Tenía que decidir cúanto comprar. ¿Qué cosa tendrá que calcular la Srta. Brown?

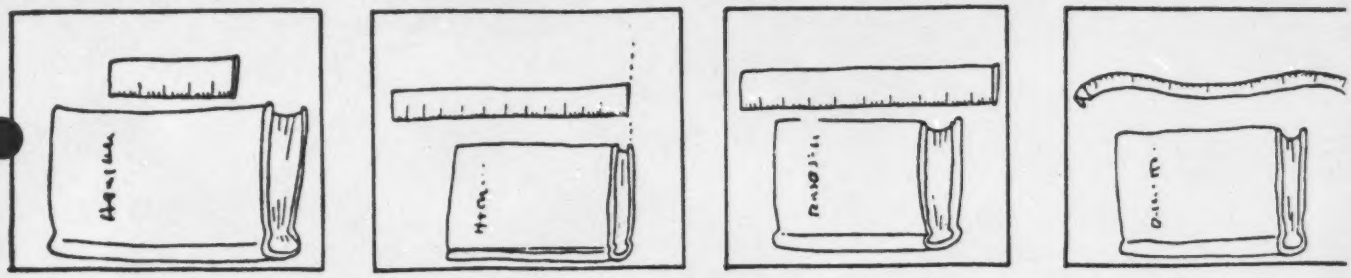
A. el área de su cuarto

B. el perímetro de su cuarto

C. la altura de su cuarto

D. el volúmen de su cuarto

13. ¿Cuál dibujo te muestra cómo hacer una medida exacta?



A B C D

14.

Todos estos líquidos son _____?

A. ácidos
B. bases
C. neutros
D. venenosos

15.

A B C D

¿Cúal de las actividades anteriores se puede hacer en aproximademente un minuto?
(Haz un círculo alrededor de la letra correcta.)

A.
B.
C.
D.

STOP

DIRECCIONES: Mira los tres dibujos en orden de la izquierda a la derecha. Escoje la palabra que mejor describe lo que está pasando. Pon un círculo alrededor de la letra al lado de tu respuesta.

16.

¿Cúal de estas palabras explica lo que le ocurre a la pelota?

A. se empapa
B. rebota
C. arregla
D. se aplana

17.

El último dibujo muestra _____ del trabajo de Jaime.

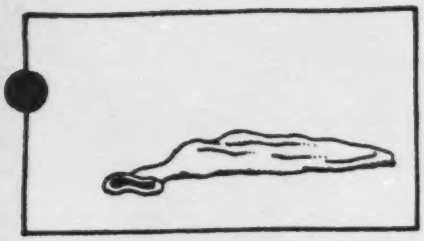
A. el diseño
B. el resultado
C. un rompecabezas chino
D. la constelación

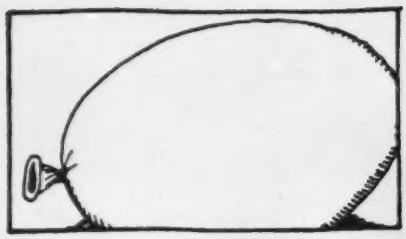
18.

¿CÚal de estas palabras describe lo que está pasando?

A. hirviendo
B. expandiendo
C. disolviéndo
D. concentrándo

19.





¿Que le occure al globo?

A. se expande
B. se condensa
C. está siendo medido
D. está siendo calculado

STOP

DIRECCIONES: Usa los dibujos para contestár las preguntas. Pon un círculo alrededor de la letra al lado de tu respuesta.

20. ¿Cómo se llaman estos objetos?

A. experimento
B. medida
C. ingredientes
D. bióxido de carbono

21. ¿Qué pone la tetera en el aire?

A. ácido
B. cristal
C. humedad
D. negativos

22. En el dibujo Judy está mirando los pescaditos para ver si en algún momento se topan. Otra palabra para "mirar" es:

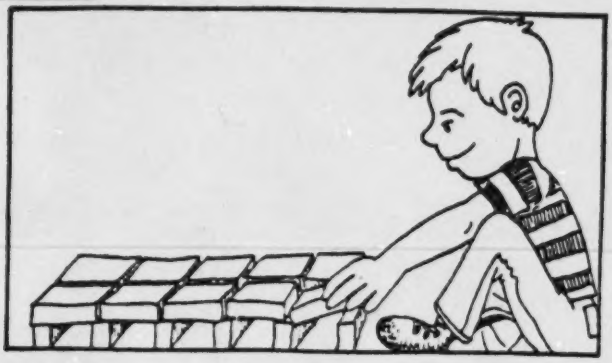
A. ocupar
B. registrar
C. reducir
D. observar

23. Jose quiere saber cómo es que un gusanito se tranforma en mariposa. Puso un gusanito en un jarro y lo va a mirar mientras cambia. ¿Cómo puede José aprender algo sobra el gusanito?

A. formándolo
B. observándolo
C. calculándolo
D. cristalizándolo

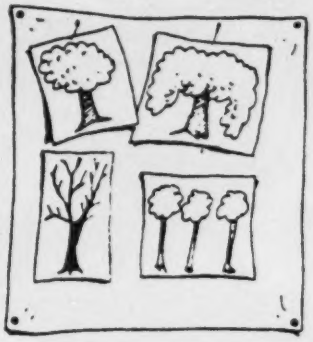
24. Antonio hizo un puente con bloques. Medía 10 bloques de largo y 2 bloques de ancho. Estas son _____ del puente.

A. la altura
B. la simetría
C. los materiales
D. las dimensiones



25. Julia dibujó varios árboles. Decidió pegar todos sus dibujos en un cartelón grande. ¿Qué cosa estaba haciendo Julia?

A. un afiche
B. un diseño
C. un pentágono
D. un perímetro



26. Para hacer una sombra tienes que tener _____.

A. luz
B. zapatos
C. el sol
D. una cámara

27. El avión vuela en una cierta _____.

A. sombra
B. distancia
C. solución
D. dirección

28. Cuando decimos que las "hojas crecen hacia arriba, y las raíces hacia abajo", estamos diciendo que cada cual crece en una cierta _____.

A. sombra
B. distancia
C. solución
D. dirección

29. Tomás se está sirviendo un refresco. Parece que echó mucho. Podríamos decir que se _____ el refresco.

A. flotó
B. reflejó
C. separó
D. derramó

30. A la abuelita de Jill se le estaba haciendo difícil leer el periódico. Dijo que las letras eran tan chicas que casi no las podía ver. Para que las letras se vean más grandes, la abuelita de Jill necesita anteojos que:

A. calcan
B. amplifican
C. reflejan
D. contraen

31. José jugaba con un elástico de hule. Lo estiró y al tocarlo hizo un sonido. El sonido fue causado por _____.

A. el grado
B. el equilibrio
C. el trago
D. la vibración

32. Susana y Sandra jugaban juntas. A la mamá de Susana se le ocurrió algo que podrían hacer. Mezcló jabón y agua. Susana y Sandra usaron esta mezcla para hacer burbujas de jabón. Otra palabra para decir <u>mezcla</u> es:

A. sitio
B. solución
C. vibración
D. pronóstico

---

33. El reportero del tiempo dijo que mañana probablemente iba a llover. El hizo _____.

A. una cantidad
B. un pronóstico
C. una estructura
D. una comparación

---

34. La familia de José salió a caminar por el lago. José miró en el lago y se vió a él mismo. A veces los lagos son como los espejos. Los dos:

A. se quiebran
B. enfocan
C. se congelan
D. reflejan

STOP

DIRECCIONES: Lee cada historia. Contesta la pregunta. Pon un circulo alredan de la letra al lado de tu respuesta.

5. La plantita de Sharon se estaba muriendo. Ella no sabía por qué. Pensó que quizá era porque necesitaba más agua o más luz. Primero Sharon intentó darle agua más a menudo. Pasaron dos semanas y la plantita todavía estaba enferma. Entonces Sharon decidió que mejor ponía la plantita al lado de una ventana por donde entraba más sol. En una semana, la plantita se mejoró muchísimo. ¿Qué fue lo que hizo Sharon para averiguar lo que le pasaba a su plantita?

A. una gráfica
B. una receta
C. una medida
D. un experimento

36. La clase del Sr. Jacobo hacía ejercicios todos las tardes. Hoy le quería enseñar a todo el mundo un ejercicio nuevo. Para hacer este ejercicio, cada uno necesitaba un compañero/a. Amy y Beth decidieron trabajar juntas. Entre los dos formarían un/a _____.

A. circulares
B. pareja
C. identicos
D. mendigos

37. Juana y Susana decidieron ir en bicicleta a la farmacia. Se encontraron en casa de Susana y se pusieron a platicar acerca de sus bicicletas. A Juana le gustaba la bicicleta de Susana por su color rojo y por su bocina. La bicicleta de Juana era azul y no tenía bocina. Pero a Susana le gustaba la bicicleta de Juana porque tenía una canasta y un asiento suavecito. ¿Qué hacian las niñas al hablar de sus bicicletas?

A. calcarlas
B. compararlas
C. medirlas
D. diagramarlas

38. El Sr. Rodríguez tuvo que remendar el techo de su casa. Iba a tener que comprar una escalera para subirse al techo. Antes de ir a la tienda salío para ver qué alto tenía su casa. Aunque el Sr. Rodríguez no tenía una cinta para medir la altura, adivinó que quizá necesitaría una escalera de 20 pies do altura. ¿Cómo hizo el Sr. Rodríguez para llegar a esta conclusión?

A. anotó la altura
B. midió la altura
C. hizo una estimación de la altura
D. estiró la altura

39. La familia de Joselito tiene un perrito nuevo que se llama Tipi. Joselito quiere que Tipi se quede en la casa durante la noche para que no le de frío, pero el Papá de Joselito dijo que el perrito tenía que quedarse afuera todo el tiempo. Joselito decidió hacerle una casita a Tipi. Su Papá le dió madera y herramientas. Lo primero que tenía que hacer Joselito era ver de qué tamaño tenía que ser la casa para que cupiera Tipi. ¿Qué podría hacer Joselito para calcular el tamaño?

A. medir a Tipi
B. encojer a Tipi
C. construir la casa alrededor de Tipi
D. construir la casa con esperanzas de que sea lo suficientemente grande

---

40. Después de clases, Jill fue a jugar a la casa de Cecilia. A la hora de que se tenía que ir Jill a su casa, se preocupó la mamá de Cecilia, pensando que quizá iba a llover. Decidió que lo mejor sería prestarle el impermeable de Cecilia a Jill para que no se mojara en el camino. ¿Cómo supo la mamá de Cecilia que las niñas eran de casi el mismo porte?

A. lo trazó
B. lo anotó
C. lo calculó
D. lo magnetizó

---

41. Tomás y Alfredo estaban haciendo pudín de chocolate. En la caja las indicaciones les explicaban cuánta leche usar. Tomás echó el polvo del pudín en un plato hondo. ¿Qué debería hacer Alfredo antes de echarle la leche al pudín?

A. calentarla
B. tomársela
C. pesarla
D. medirla

---

42. Ana necesitaba una linterna para poder ver si su gato estaba debajo de la casa. Cuando encendió la linterna, vió que no funcionaba. Pero Ana no estaba segura de lo que le pasaba a su linterna. Tal vez necesitaba un nuevo foco, o quizá baterias nuevas. Para averiguar, Ana primero le puso baterias nuevas primero. La linterna no funcionó, así es que Ana pensó que lo que necesitaba era un nuevo foco. ¿Qué hizo Ana para averiguar que le pasaba as su linterna?

A. una gráfica
B. una receta
C. una medida
D. un experimento

FIN DE LA SECCION II

Appendix D

Sample Worksheets in English & Spanish

FINDING OUT F-S-E-16

~Heat and Sound~

SHRINKING RUBBER BAND

FIELD TEST VERSION

Name _____

What happened:

_____

_____

_____

How long did the extra strength last?

_____

Is the rubber band the same length as before? _____

How do you know?

_____

_____

F-S-S-16
DESCUBRIMIENTO
EJEMPLAR EXPERIMENTAL

- EL CALOR Y EL SONIDO -

EL ELASTICO QUE SE ENCOJE

Nombre _____

¿Que pasó?

_____

_____

_____

_____

¿ Cuánto dura la fuerza adicional?

_____

¿ El elástico queda del mismo largo después del experimento?

_____

¿ Cómo sabes?

_____

~ Change and Measurement ~

ANCIENT BODY MEASURE

Team Names _____ _____

1ST Person 2ND Person

The body measure we will use:

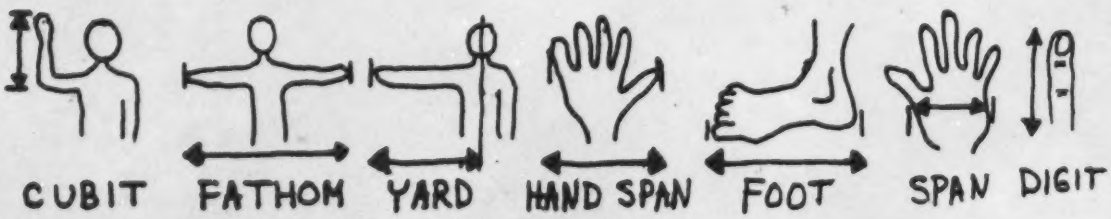
a _____.

OBJECT	1ST Person's Measure	2ND Person's Measure
table	10 spans	9 spans

What we found out was that:

_____

_____



A-M-S-01
Descubrimiento
EJEMPLAR EXPERIMENTAL

~El Cambio y La Medida~
MEDIDA ANTIGUA DEL CUERPA

Nombres de Equipo _____ (1era Persona) _____ (2nda Persona)

La medida del cuerpa que usaremos: un/a _____.

OBJETO	MEDIDA DE LA 1era PERSONA	MEDIDA DE LA 2nda PERSONA
mesa	10 cuartas	9 cuartas

Lo que averiguamos fue que: _____.